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119 — *Journal Section of the American Society of Heating and Ventilating Engineers*

Like a porcupine: Steel strips spread out from well casing to take heat from the ground—see page 90

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Sam, you better SCRAM!

Who said steam boilers are on the way down?

From time to time certain people have forecast a dismal future for Sam's kind of boilers. "Steam," they said, "is on the way out!" Now that we have some statistics in the heating industry, it's surprising to see how wrong they are.

Note, for example, that the latest figures from I-B-R show that 41.8% of the cast iron boilers shipped during the first six months of 1947 are steam. Instead of being on the way down, the steam percentage has *increased* over 1946 figures! This isn't accounted for by big boilers either. Small boilers showed a higher percentage than at any time since the records were kept: 55.9% of the steam boilers shipped were under 550 feet.

Note also that R. E. Ferry of the I-B-R gives facts in a recent article that enable you to translate these percentages into boilers. He says cast iron boiler replacements can be expected at a rate of 100,000 annually, confirmed by the fact that there are over 4 million in service with an estimated life of 40 years (F.H.A. figures).

In terms of business for you, this means there will be about 41,000 steam boilers for replacement alone. All of them need McDonnell Boiler Water Level Controls. More than half of them (57.9%, says I-B-R) will be automatically fired—all ready-made prospects for the McDonnell No. 47-2 and No. 67 illustrated here. On top of this you have the boilers for new buildings and the millions of old boilers that need protection to insure their full life span. A lot of them are in your locality. Surely you'll go after your full share. Ask for latest sales helps, information and prices.

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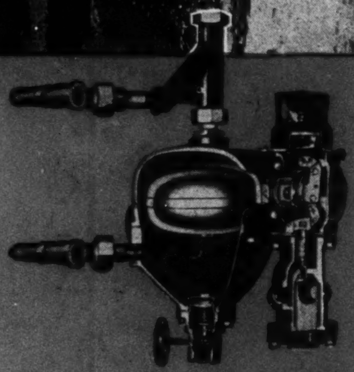

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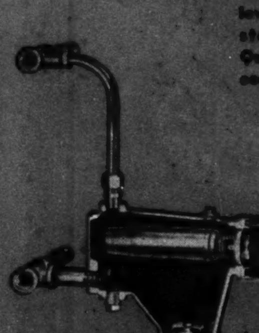

No. 67 Low Water Cut-off for all automatically fired boilers; maximum steam pressure, 25 lbs.

No. 150 Water Level Control for boilers of any size with steam pressures up to 150 lbs. Used as feed-pump control; low-water fuel cut-off; low water alarm switch, or any combination of these functions.

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Journal Section of the American Society of Heating and Ventilating Engineers

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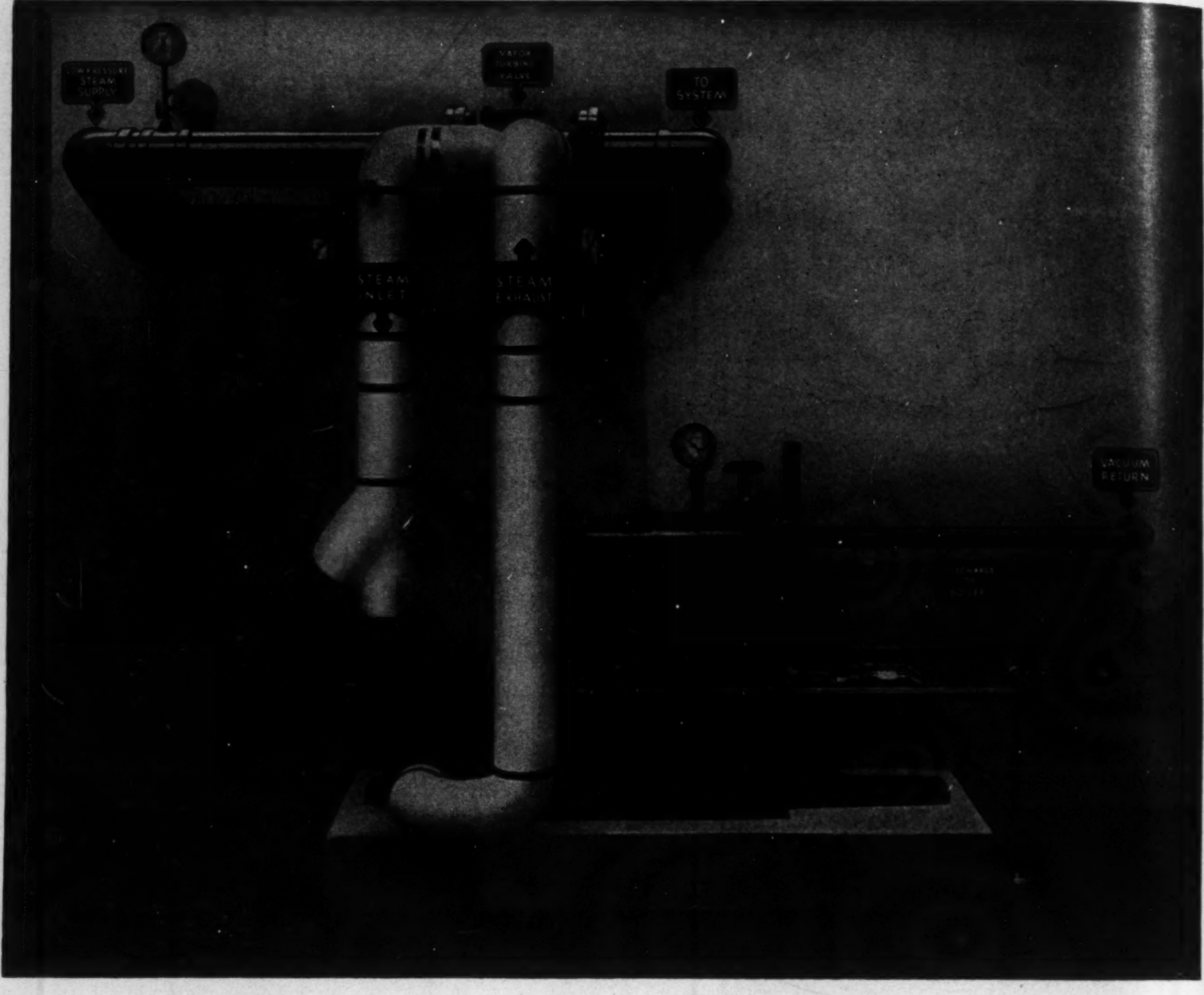
Interrupted Electric Service will not stop this NASH Heating Pump



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

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STAINLESS STEEL PIPING
Fabrication by Welding

Welding Schedule 10 stainless steel pipe and fittings by the inert gas-shielded arc process (courtesy Linde Air Products Co.)

The problems involved in the fabrication of stainless piping systems by welding can be broken down into three general headings: preparation for welding, welding process, and heat treatment after welding.

Preparation for Welding

Ordinarily, the matter of handling the material up to the moment of welding is not thought of as part of the preparation for welding. In the case of stainless steel, and particularly in the case of piping lighter than standard weight, this is probably as important an aspect as any of the overall problems. Since there is obviously a considerable difference in the rigidity of standard weight pipe and Schedule 10 pipe or featherweight tubing, the last two are much more capable of being damaged by rough handling than the first. Since the material even in its lightest form is extremely expensive, the contractor will be well repaid by keeping it in its original containers (it will normally be shipped in wood boxes or cartons) up to the moment it is ready for use, if at all possible.

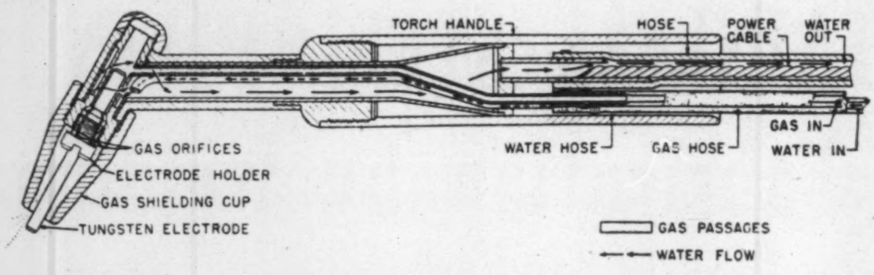
Next under the heading of preparation is the matter of cleaning. Primarily this has to do with the elimination of any possibility that the material, while being welded, will pick up carbon or that, in the cleaning process, particles of carbon steel will be embedded in the stainless steel. As mentioned in the first article of this series, the carbon content of stainless steel has a great deal to do with its corrosion resistance. If there is oil or other carbonaceous material in the vicinity of the weld while it is being made, some carbon is likely to be picked up by the molten metal. If this happens, the corrosion resistance of the joint may be considerably reduced. Hence, it is absolutely essential to have clean material ready for the welder.

Cleaning, of course, includes the removal of slag or flux during and after welding and of weld spatter and heat discoloration caused by welding. The complete removal of slag and the descaling of craters during the welding operation is required in order that no focal points for corrosive attack remain in the deposited metal. In welding carbon steel it is customary to use steel wire brushes, chipping hammers, and occasionally grinding wheels, or even steel wool for cleaning and dressing. When dealing with stainless steel, these same tools may be employed except that wire brushes and steel wool should be made of stainless steel and only grinding wheels which have been used solely for stainless steel should be permitted. The purpose is to avoid leaving on or embedded in the stainless steel surface small particles of carbon steel which may become the starting points of corrosive attack due to galvanic action.

The subject of cutting may also be included under the general heading of preparation. Three methods are being employed, namely, mechanical cutting, gas cutting, and a new process called oxy-arc cutting.

Mechanical cutting has thus far

J. D. MATTIMORE, chief engineer, product engineering and research, Tube Turns, Inc., reviewed the reasons for using stainless steels and explained standardization of pipe thicknesses of three types of stainless piping in the October HPAC. Last month he described how pipe joints are selected to maintain sanitary conditions, to avoid contamination of products, and to reduce the possibility of corrosion. This month he discusses the preparation of stainless pipe joints for welding, welding processes, and heat treatment after welding



The inert gas-shielded arc welding torch shown here utilizes one electrode, provides a shield of inert gas to prevent oxidation of the molten metal, and is water-cooled (courtesy Linde Air Products Co.)

been most generally employed in the cutting of stainless steel pipe but obviously it is expensive for the preparation of branch connections and the making of plate flanges.

Two of the large gas welding equipment manufacturers recently developed special gas cutting equipment for use on stainless steel (the ordinary oxyacetylene and oxygen lance methods are not suitable for cutting stainless because of the refractory nature of the chromium oxides which form). The special gas cutting equipment in which a finely divided powder is blown or aspirated into the oxygen stream has worked out well for cutting plates and heavy material but to date has not been utilized to any great extent in the cutting of pipe, particularly in the preparation for branch connections.

The oxy-arc process is a still newer process and combines an electric arc welding machine with a hollow coated electrode through which oxygen is fed from the usual oxygen cylinder. The electrode holder is specially designed to permit the introduction of the oxygen into the electrode. In at least one instance of which the writer knows, this method is being used for preparing pipe for branch welds with satisfactory results.

Thus far the discussion has been devoted to preliminary phases of weld preparation. Turning next to joint preparation proper, there remains to be discussed under that heading, the subjects of end preparation, joint alignment, and the use of welding rings.

In carbon steel piping, the 37½ deg bevel with 1/16 in. land or root face is, of course, the American Standard for thicknesses ranging from 3/16 to ¾ in. The American Standard for Steel Butt Welding Fittings, ASA B16.9, states that "welding ends having thicknesses less than 3/16 in. shall be prepared with a slight chamfer or square in accordance with manufacturer's practice." Actually most carbon steel butt welding fittings in sizes down to ½ in. standard weight iron pipe size, which has a nominal thickness of 0.109 in., are furnished with 37½ deg beveled ends. Since a large percentage of stainless steel piping will have a wall thickness of 3/16 in. or less, serious consideration should be given to the need for beveling the pipe and fitting ends. Full penetration in making butt welded joints is always desirable. In the case of stainless steel, full penetration is essential if small pockets are not to be formed where bacteria can grow, where contaminating corrosion or "aging" products can form, or where concentration cell corrosion, with resultant pitting, can begin (described by the author last month). Hence, beveled ends, which aid in attaining full penetration, are desirable at least for thicknesses as light as 12 gage. However, it is very difficult to bevel light gage pipe or fittings and simultaneously to maintain the true circularity of the ends even when the beveling is performed in special purpose machine tools. As the ratio of diameter to thickness increases, this difficulty is enhanced. From this standpoint it is presently impractical to fix the limits of diameter and thickness at which beveling can be economically performed.

For the same reasons that beveling is highly desirable, accurate fit-up of the abutting joints is important. Having in mind standard weight and heavier piping, the codes require that the offset in a joint due to differences in diameters and wall thicknesses (within commercial tolerances) be held to 20-25 percent of the wall thickness. When dealing with wall thicknesses of ¼ in. or heavier, this is a relatively simple requirement to meet. When the wall thickness is of the order of ⅛ in. or less, a good deal more care is required in selecting pipe ends that match each other well, jigging them to maintain the fit-up during welding, and in extreme cases, flaring or swaging the pipe ends to insure adequate roundness and correct diameters. The careful handling of the pipe and fittings up to the moment of welding, as described in the foregoing, will minimize the cost of properly aligning the abutting ends.

A review of the points thus far discussed will lead to the conclusion, which incidentally has already been put into practice by those who have had experience with stainless steel pipe fabrication, that each job should be so planned that the maximum amount of prefabrication can be done either in the contractor's permanent shop or in a well equipped field shop under as nearly ideal conditions as can be attained.

Under the general heading of joint preparation, it is appropriate also to discuss the use of welding or backing rings. Except when stainless steel piping is being employed only because of extreme temperature conditions or because of the embrittling nature of the fluid, welding rings, generally speaking, cannot be employed. This is because, of necessity, they create internal pockets in the pipe. It was pointed out last month that such pockets are highly objectionable in most stainless steel applications. Since welding rings are primarily employed to insure thorough penetration of the weld to the joint root and since such penetration is, if possible, more important in stainless steel work, the obvious conclusion is that the welder must exercise more care and skill in stainless steel welding than has been required of him in carbon steel welding under code requirements. This is because he will normally not have the benefit of a welding ring in making the welds.

Welding Processes

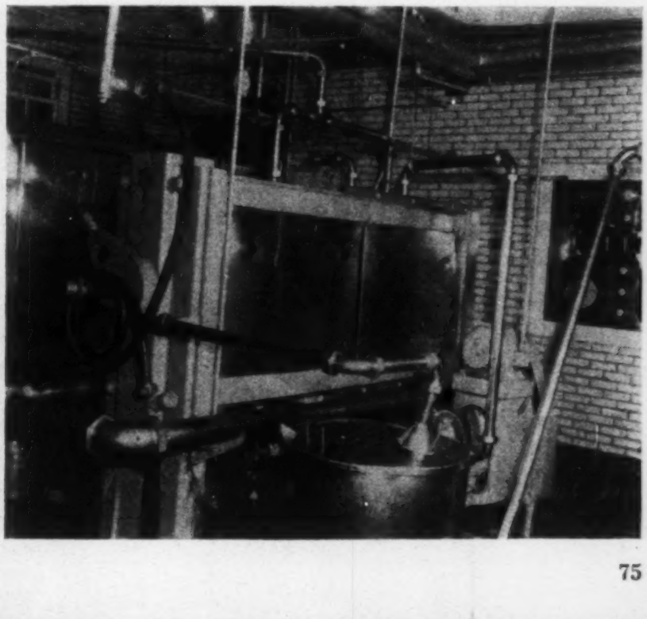
It is natural to turn first to the oxyacetylene process. Not only is it the first fusion welding process to have been applied to piping but for small diameter and for light gage work it has long been considered a most suitable process because of the ease with which it can be manipulated and because of the control the welder can maintain over it in striving for complete fusion. Beyond that, for those classes of work it is probably true that there are a large number of operators available who are skilled in its use. These reasons naturally cause it to be given primary consideration by those who are faced with the welding of light gage stainless piping for the first time. This reasoning is sound except for one vital point. As has previously been said in the first article of this series, the stainless steels under discussion are subject to a reduction in their corrosion resistant properties both when exposure to temperature in the range of 800 to 1600 F causes carbide precipitation and when the surrounding environment is such as to permit the molten deposited metal to pick up carbon. As is well known, the oxyacetylene process heats a greater area of the pipe to a higher temperature than do the electric welding processes. Hence, the heat affected zone reaches a higher temperature and is maintained in that temperature range longer (due partially to the lower heat conductivity of stainless steel) than would be the case with electric arc welding. Again, the best authorities recommend an absolutely neutral flame to avoid oxidation of the stainless steel, which causes porosity, and to avoid carbon pickup by the weld metal, caused by a flame which is slightly reducing. Even when the best efforts to accomplish these flame conditions have been made, there are indications that the carbon content of the weld metal may be materially increased over that of the adjacent parent metal, the additional carbon having been picked up from the flame. Clearly this means a considerable reduction in the corrosion resistance of the weld proper. Still another disadvantage of the oxyacetylene process is that for best results a flux should be employed. This poses the problem of removing the flux from the interior of the pipe after welding, which may be difficult to accomplish.

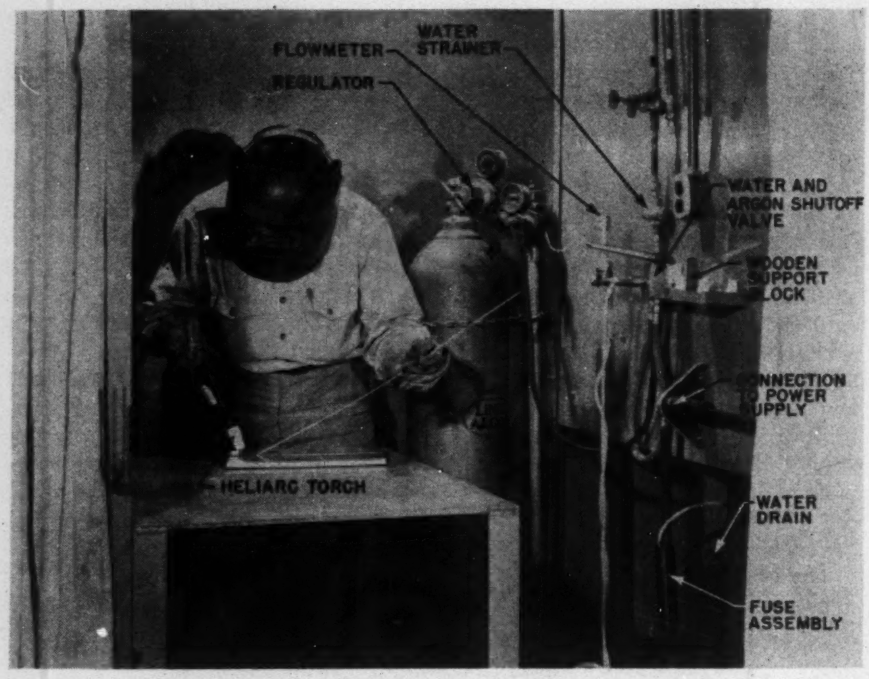
Shielded Metallic Arc Welding Process

The direct current shielded metallic arc process is presently looked upon by those who have investigated the subject as the most suitable now available for stainless steel piping. This is because of the high state of development of that process and because it eliminates all of the objections just mentioned against the employment of the oxyacetylene process. This judgment is probably correct for standard weight pipe 2 in. and larger. On the other hand, the employment of d-c shielded, metallic arc welding for pipe which has a wall thickness of ⅛ in. or less requires a high degree of skill. It is necessary to use 1/16 to 3/32 in. electrodes (to which most pipe welders are not accustomed) and, even with these, considerable care must be taken to avoid burning holes in the pipe and yet to insure obtaining full penetration. For each combination of wall thickness and electrode size there appears to be an ideal speed of welding having a very limited range of variation which will avoid the opposing hazards of burning through and failure to get penetration. From what has been said on this point, it should be clear that close regulation of the output of the welding generator is desirable. This means using a machine capable of being satisfactorily regulated to at least half the minimum welding current normally employed with ⅛ in. carbon steel electrodes and it also means frequent cleaning of the generator and replacement of its brushes. It is desirable to use an ammeter and a voltmeter on the output side of the generator so that the machine can be accurately adjusted. Although a-c welding can be employed in welding stainless steel, possibly to some advantage over d-c welding, its need for special power circuits has made it unpopular in most pipe fabricating shops and has almost wholly prevented its use in field shops and for field welding.

The inert gas-shielded arc welding process, in which the inert gas is either helium or argon (the gas being used to shield the molten deposited metal and prevent its oxidation), and the atomic hydrogen process have been applied successfully to the welding of stainless steel in general. The atomic hydrogen process has the disadvantages that it is not well suited for any but

Left: Welded stainless piping is used to handle dental cream at the Colgate-Palmolive-Peet Co.'s plant at Jeffersonville, Ind. Right: Handling slurry in the manufacture of a detergent type cleansing fluid at the same plant is a typical application of welded stainless piping





The inert gas-shielded arc welding process using helium or argon is relatively new

flat work and that the double electrode torch, by reason of its weight, is somewhat difficult to manipulate.

Inert Gas-Shielded Arc Welding Process

The inert gas-shielded arc process using helium or argon gas is relatively new, having been commercially applied only since 1942. For manual welding, the gas generally employed is argon because it is less expensive and because it is a heavier gas than helium, thus providing a more effective shield for the molten metal. Because the process has only begun to be utilized in welding pipe, it is briefly described here.

The equipment consists of a d-c welding machine, an electrode holder, a tank of argon gas, a source of cooling water or air, the necessary electric cable, the hoses to bring the argon and cooling fluid to the electrode holder, and regulators to control the flow of argon and the cooling medium. The electrode holder is specially constructed to contain the proper size metal electrode (only one electrode is employed) around which is placed a ceramic shield to direct the flow of argon toward the molten metal. The argon flows through the torch, of course, as does the cooling medium which is supplied to prevent rapid consumption of the metal electrode. In one design of torch the return path of the coolant is through a hose surrounding the electric cable supplying the current to the electrode, thus cooling it also and thereby making it possible to reduce its size and weight.

In applying the process, an arc is drawn between the single metal electrode and the work with straight polarity being used (where the ordinary d-c shielded metallic arc process is employed, reverse polarity is required). A bare wire is employed and, in general, the weld is made much as would be the case with oxyacetylene equipment. The process has the same advantages as does the oxyacetylene process and largely avoids the latter's disadvantages. For these reasons, it offers promise of being a most suitable process for welding stainless pipe ⅛ in. and less in thickness. However, there are two points which must be kept in mind in connection with this type of inert arc welding. It is essential that the welder so manipulate the electrode holder, as he progresses around the pipe, that the argon being emitted from it is always directed toward the molten puddle. Failure to do this may result in a partially oxidized, partially porous weld. Again, it must always be remembered that the argon, after it leaves the electrode holder, may be blown away from the weld by a relatively low velocity air current. In using the process in the shop, a shield to prevent such air currents reaching the weld area is desirable; for outdoor work such a shield is essential. The process probably should not be used out-of-doors in a strong wind.

From this brief discussion of the fusion welding process, it may be seen that there is as yet no single process which is completely satisfactory for welding all grades, sizes, and thicknesses of stainless steel pipe. Hence, the process should be selected to fit the conditions of the particular installation. In addition, it must be said that new developments in the application of the various processes are constantly taking place. The foregoing discussion, therefore, presents only what is currently considered as good practice in the field of stainless steel pipe welding.

Heat Treatment

It is probably correct to say that the majority of stainless steel piping which will be installed will not require heat treatment subsequent to welding.

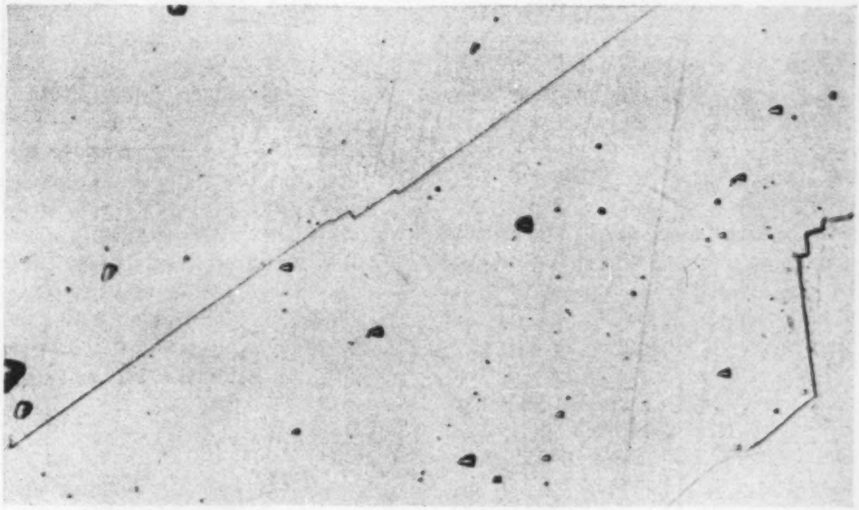
The heat treatment of carbon and low alloy steel piping, after welding, is carried out to avoid cracking, to reduce residual stresses, to improve the physical properties of the weld, or possibly all three of these. Generally speaking, these reasons do not apply to the heat treatment of stainless steel. The most common reason for heat treating stainless steel is to restore its corrosion resisting properties which may have been reduced by carbide precipitation having taken place as a result of welding. In the fusion welding process, the weld metal itself and the heat affected zone obviously must pass through the temperature range of 800 to 1600 F which is known to cause carbides to precipitate. The longer the metal stays in that temperature range, the more precipitation will take place. As indicated in the first article of this series, type 347, because it has columbium added to it to reduce the carbide precipitation tendency, is commonly employed in place of type 304 to eliminate the necessity of heat treatment subsequent to welding.

As normally carried out, the heat treatment of stainless steel consists in raising the temperature of the welded assembly to 1900-2050 F and then quickly cooling it to at least 800 F in order to get it through the range of 1600-800 F as rapidly as possible. In the case of lightweight pipe such as Schedule 10 or even the smaller sizes of standard weight, the cooling can be accomplished by means of an air blast. For larger and heavier pipes, the use of a water spray or a water quench tank is necessary. This heat treatment is commonly known as annealing. A more accurate term is solution heat treatment since its object is to put back into solution those carbides which have precipitated as a result of welding. The annealing process is employed for types 304, 347, and 316.

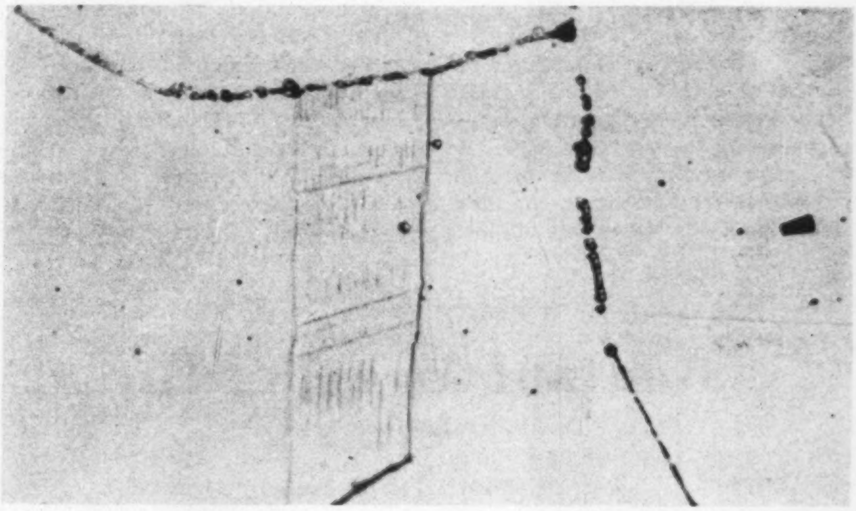
A second heat treatment process generally used for type 347 when used for pressure vessels has been termed stabilizing. It consists in raising the metal to a temperature of 1500 to 1650 F, holding at that temperature for two hours minimum, and cooling in still air or a furnace. The purpose of the treatment is based on the fact that type 347 does not perfectly resist carbide precipitation when being welded. The stabilizing treatment is applied to enable the columbium to form columbium carbides to the greatest possible extent in a reasonable period of time so that the chromium present will be free to provide the maximum corrosion resistance. Thus, this treatment is intended to reduce local corrosive attack which, when once started, is likely to proceed at an accelerated rate. It, of course, effectively relieves locked up stresses caused by welding.

A third kind of heat treatment is known as spheroidizing. It is applied only to type 316 and usually only to pressure vessels and consists in holding the metal at a temperature of 1600-1650 F for 72 hr. The purpose of this heat treatment is to place the unit in a state of minimum internal stress and to stabilize the steel. It is understood that in some severe services, this treatment has reduced the rate of corrosion attack as much as 50 percent.

When heat treatments of the types described must be used, it is desirable to pickle the metal after the stabilizing or spheroidizing heat

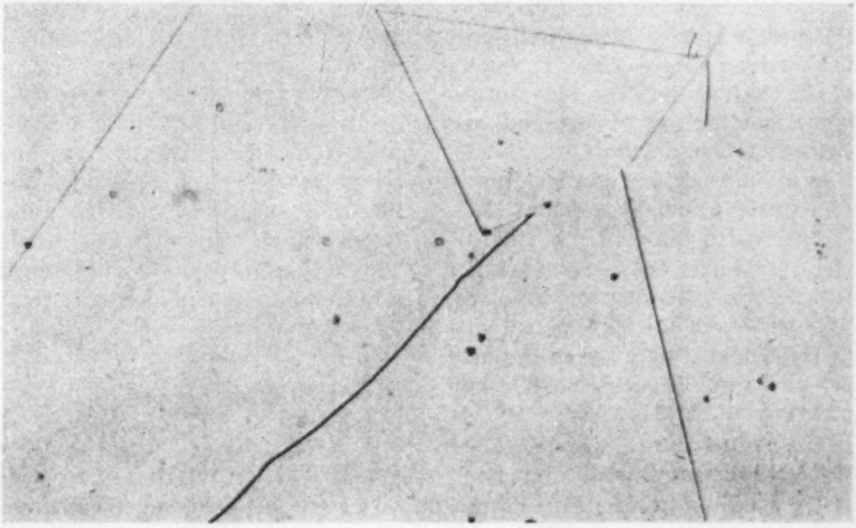


The absence of carbides in the grain boundaries of type 304 stainless steel, before welding, is shown in this photomicrograph, enlarged 1000 times



Above: Precipitated carbides in the grain boundaries of type 304 stainless result from arc welding (enlargement, 1000 diameters)

Below: Heat treatment after welding eliminates carbide precipitation in the grain boundaries of type 304 stainless steel. This photomicrograph again shows the same section enlarged 1000 times



treatments and it is quite necessary to do so in the case of the annealing process to remove the scale which has formed. The difficulty and cost of heat treating and pickling fabricated assemblies are such as generally to warrant the higher initial cost of types 347 and 316, if by their use the heat treatment of type 304 (the least costly of the three alloys) can be avoided. Incidentally, it is usually true that carbide precipitation caused by welding type 304 is harmless—that is for mildly corrosive service, such as is encountered in many food handling processes and where contamination from corrosive products (formed by the action of the fluid on the pipe) are the primary factors governing the selection of stainless steel. For this reason type 304 welded piping systems, not heat treated, have many applications.

In this general connection, it should be pointed out that local heat treatment by torches, small furnaces, or electric resistance or induction heaters cannot be employed in heat treating stainless steel pipe welds. Obviously all such devices simply transfer the heat affected zone from the weld to the end of the locally applied source of heat where carbide precipitation will take place.

Before a contract is entered into to fabricate and erect a stainless piping system, it is absolutely essential that a clear understanding be reached between the owner and contractor as to what welding process shall be employed and, if heat treatment is required, which type of heat treatment shall be used.

Other Joining Methods

Among the processes being employed in joining stainless steel piping, soldering and brazing must be included. While neither of these cause fusion of the base metal, they are designated by the American Welding Society as welding processes. At first thought, they do not seem appropriate for use with stainless steel. Nevertheless they are extensively employed when stainless is chosen for sanitary reasons and for uses where the desire to avoid fluid contamination is the deciding factor. However, judgment must be used in applying these processes. The presence of dissimilar metal in the joint may cause galvanic corrosion. Again, when solders or brazing alloys are employed, they may have a chemical action on the fluid which will be undesirable.

Silver brazing alloys are extensively used in the food handling industry, especially in the dairy industry, to assemble stainless steel piping. Quite frequently the joints are made in a field shop, special equipment being required. For the most part, the valves and fittings for food handling are made by specialty manufacturers and arranged for union connections to the pipe. The pipe is purchased in random lengths and fitted with special, sanitary type, silver brazed unions by the contractor. The cut lengths of pipe are usually made 10 ft or less in length for ease in periodic disassembly for purposes of sterilization. The male and female faces of the unions are generally refaced by the contractor after brazing the unions to the pipe.

Radiant Heating for -32 F Weather

PERHAPS THE largest multi-story structure in the middle west to incorporate a radiant heating system is the new American Procurate building erected for the Sisters of Mercy of the Holy Cross at Merrill, Wis.

The building is of reinforced concrete with a stone facing and is in the form of a huge cross. The arms of the cross contain the dormitories, offices and school rooms and are three stories in height, 42 ft x 130 ft. The middle portion of the arms is four stories in height and 90 ft wide. Connected to the center portion of the building is the chapel portion which forms the stem of the cross. This portion of the building extends at right angles 150 ft from the offices and administrative part of the building.

The chapel is in a modern gothic style and the administration portion of the building in a modern design.

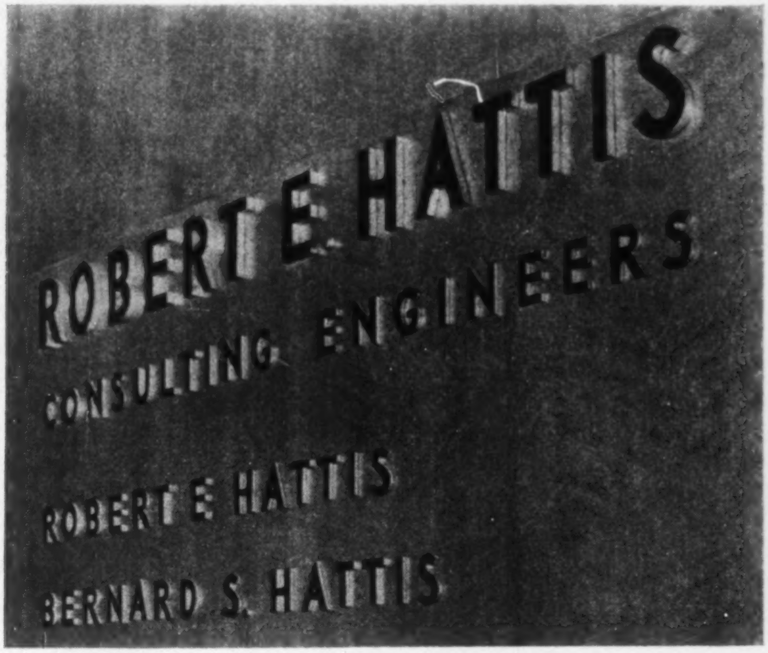
Nearly nine miles—47,000 lineal feet—of wrought iron pipe was installed in the floor of the first story chapel and lobby entrance and in the ceiling of the administrative and residential wings in the construction of the radiant heating system. The problem of adequately heating the structure was complicated not only by the large size of rooms and high ceilings but also by the fact that Merrill is located in a cold zone with low average temperatures. Thus the system, unlike those employed in many other structures throughout much of the United States, was designed to meet a minimum outdoor temperature of 32 F below zero.

Pipe Grids for Stairways

A novel feature of the heating system is the fact that pipe grids also were installed under each section, or pitch, of the stairways, to control downdraft cold air currents in the stairwells.

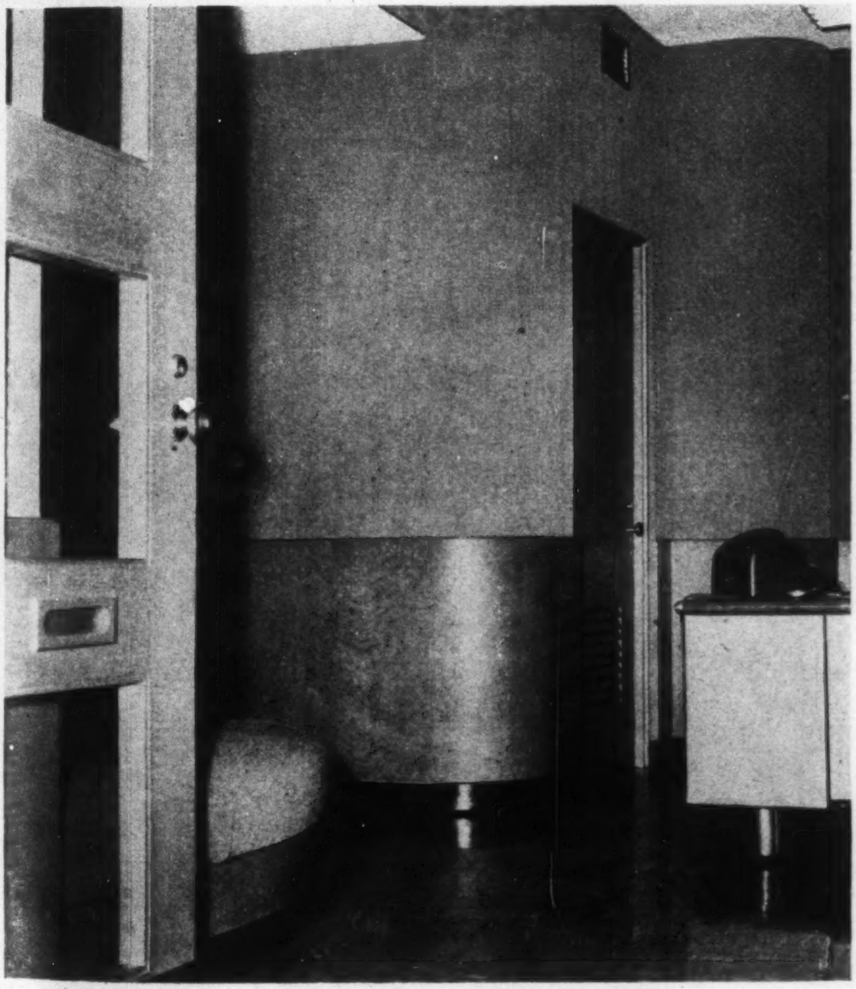
Two heat exchangers, converting steam supplied by two stoker fired boilers (each rated at 12,500 EDR) provide hot water circulated through the pipe coils of the system. Bin-feed stokers supply fuel to the boilers. Pumps from 1 to 5 hp were installed to provide circulation of the water in the four zones into which the structure was divided for heating.

The architect is Ray R. Gauger, chief architect, Walter Butler Construction Co.; general contractor, Walter Butler Construction Co.; designers of the radiant heating system and ventilation, Samuel R. Lewis & Associates; chief engineer in charge of construction, C. W. Oslund, Walter Butler Construction Co.; and heating contractors, J. McClure-Kelly & Co.



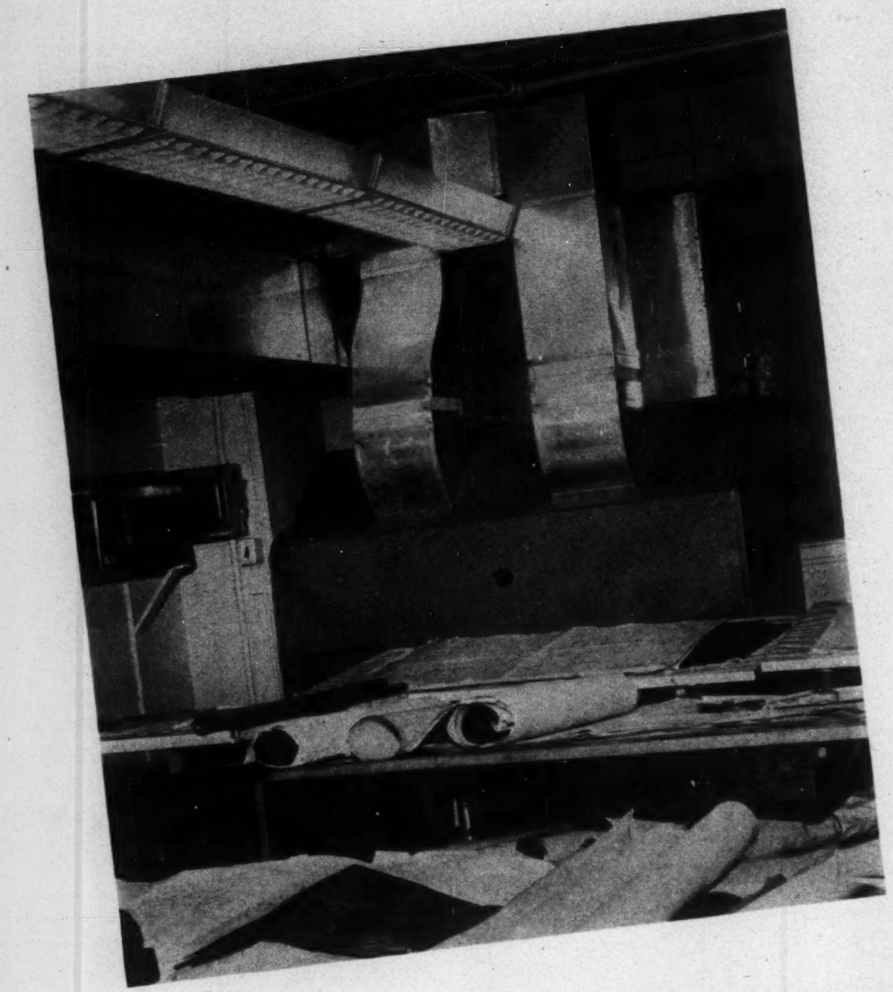
Raised letters on the wall of the sixth floor building corridor, adjoining the entrance to the office, leave no doubt as to where you're going

Air Conditioned Engineering Office Planned for Comfort and Efficiency



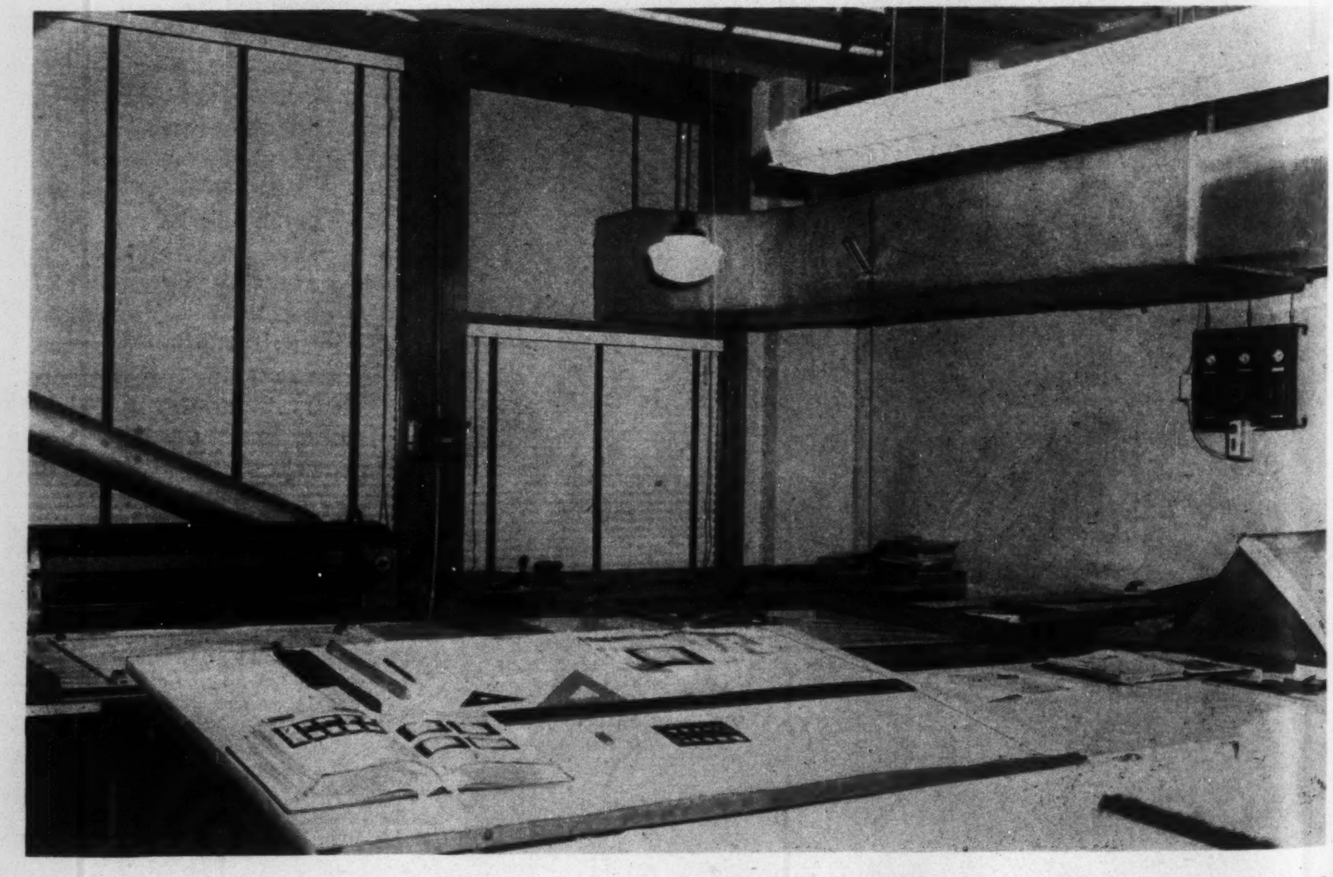
Facilities that any engineering office of comparable size—or engineering department of a plant or institution—might envy are provided by the new quarters of Robert E. Hattis, Consulting Engineers, Chicago. Occupying 2800 sq ft of remodelled space in an older building, the layout provides an attractive reception room, private offices for the two principals of the firm (father and son), a drafting room for two supervisors and 21 men on the boards, as well as service areas for filing, storage, and many conveniences not usually found in offices of this kind. The entire suite is air conditioned for comfort and efficiency.

The attractive reception room as seen through the entrance doors. Doors at the left lead to the two private offices, and behind the stenographer's desk at the right is the door to the drafting room. On the reception room wall to the right of this picture (not shown here) are two large maps with washable surfaces, one of the city and its environs and the other of the United States. Locations of current projects of the firm are indicated on these maps. There's a comfortably upholstered bench for the visitor at the left



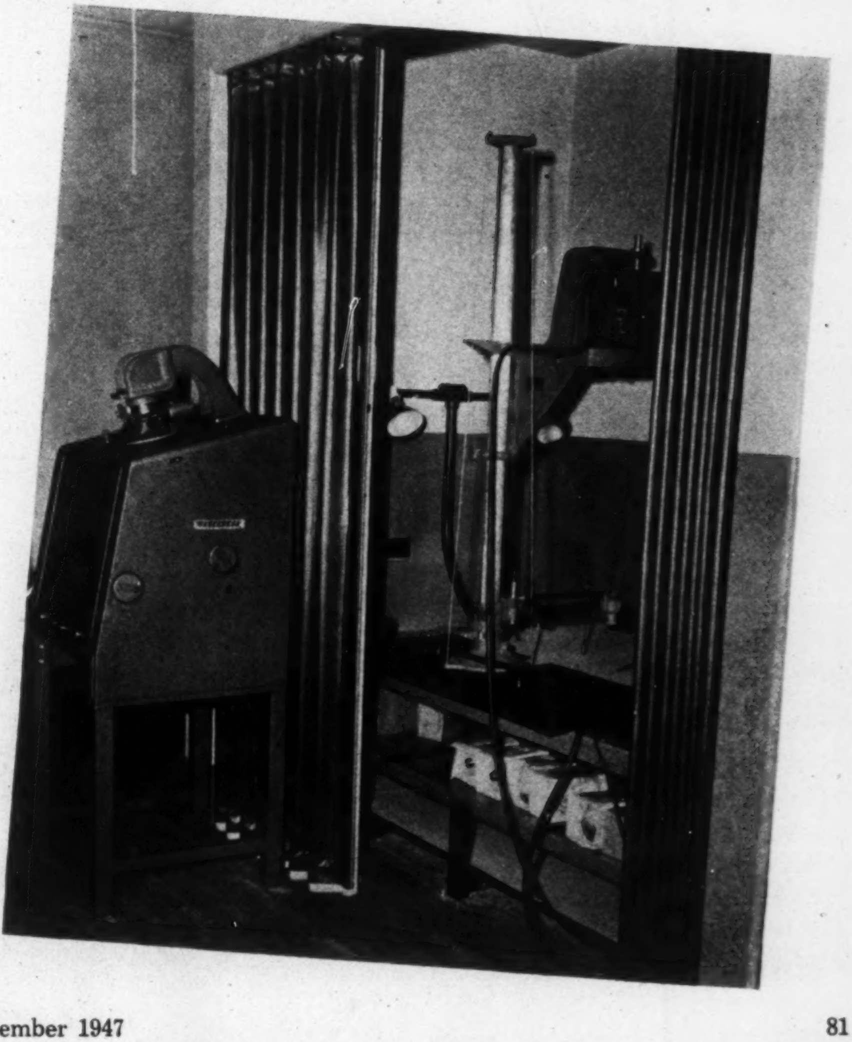
A 7½ ton central station air conditioning unit in the northwest corner of the drafting room serves the entire suite through aluminum ductwork. The owner designed the air conditioning system, and the contractor was the Acord Ventilating Co. Convector radiators with steel radiating fins, supplied with steam from the building's boiler, carry the heating load. Between each pair of adjustable drafting tables is a reference table, and a shelf running along the entire side of the room provides convenient space for bulky catalogs. The end of this shelf may be seen at the left side of this view

There is a "white print" machine at the south end of the drafting room, normally screened by a venetian blind hung from the ceiling and running almost the full width of the room; the blind was raised to take this photo. At the right is the outdoor air intake for the air conditioning system, insulated up to the point where the outdoor air is mixed with the circulated air. The air conditioning control panel is mounted on the wall where the duct insulation ends



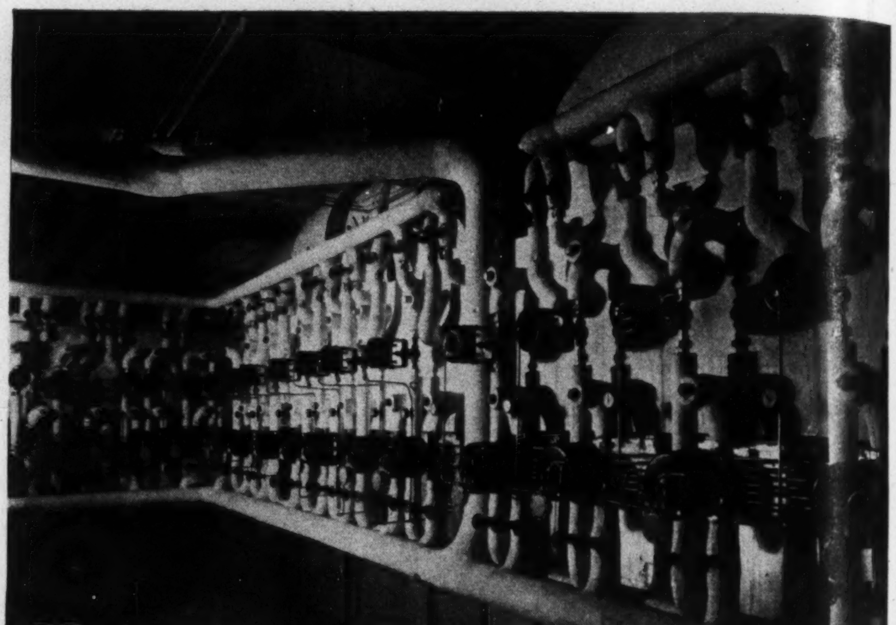
Robert Hattis' private office is complete with built-in bookcase and storage cabinets at the left, filing cabinets, conference table and chairs, and desk. On top of the file drawers to the left of the desk is a wire recorder which is used to preserve details of conferences. This photo was taken from the doorway between the reception room and this private office

(Photos by Marvin Haiman for Heating, Piping & Air Conditioning)



Among the facilities of the office is this microfilm camera, kept out of sight behind drawn curtains which have been pulled aside for this picture. To the left is the microfilm viewer. Microfilming engineering drawings and specifications saves file space, and provides copies of large drawings which are easy to carry and handle on out-of-town trips of the staff. There is also a small but complete photographic darkroom, and locked storage space for the many testing instruments used in checking on the job

Fig. 1—Individual ducts go to each room, each duct having a separate booster coil and a cooling coil. Two control valves are provided for each duct, as one room might be calling for heat at the same time another room required cooling



Individual Heating-Cooling Ducts Supply Each Room of New Building

GERALD C. DITTMAN, mechanical engineer, Schmidt, Garden & Erikson, architects and engineers, Chicago, explains the rather unusual heating and air conditioning system installed in the new addition to the National Aluminate Corp.'s windowless office building. The method practically duplicates that employed for the original building when it was constructed 10 years ago (and which was described in our February 1937 issue). Individual ducts—each with a booster heating coil and a cooling coil—supply each room of the building. Chilled water is furnished by steam jet refrigeration, the steam being supplied from the existing boiler plant which must be kept in operation in the summer anyhow for process work

TEN YEARS AGO the National Aluminate Corp. completed and moved into a new office building in the Clearing industrial district of Chicago [see HPAC, February 1937]. Its white terra cotta walls, blue trim, modern appearance, windowless construction, and complete air conditioning were features designed to make it a really pleasant place to work—but they were concepts new enough to place the project in the class of an experiment in this ultramodern type of construction.

Ten years of operation have proved the experiment to be a successful answer to the distracting problems of noise and dirt that are normally considered inevitable in the heart of a busy industrial district. That the general health and productivity of office personnel have improved in these quiet and pleasant surroundings is a certainty. Likewise (while it was certainly a very minor factor in promoting its construction) there is little doubt that the modern, clean, and efficient appearance of the building—both inside and out—has performed a public relations service that must be credited with more than a few product sales.

Add to these advantages a decrease in personnel turnover, the pride each employee takes in his company's office, and you have more than enough reasons why recent expansion has taken the form of an office addition incorporating equipment and construction details that are practically duplicates of those of the original building.

The details of construction and air conditioning of this truly modern structure will be of interest to heating and air conditioning engineers, and to any manufacturing executive who now, or in the future, may contemplate a new office building.

The new addition is approximately 50 ft wide by 135 ft long and two stories high. The building is of reinforced concrete, skeleton type, with 13 in. masonry walls, 2 in. furring lath and plaster. The roof is insulated with 2 in. granulated cork block provided with tar and gravel. The interior of the building is tile with plaster partitions. Acoustic ceilings have been provided throughout and the floors are either rubber or asphalt tile block.

Individual Ducts to Each Room

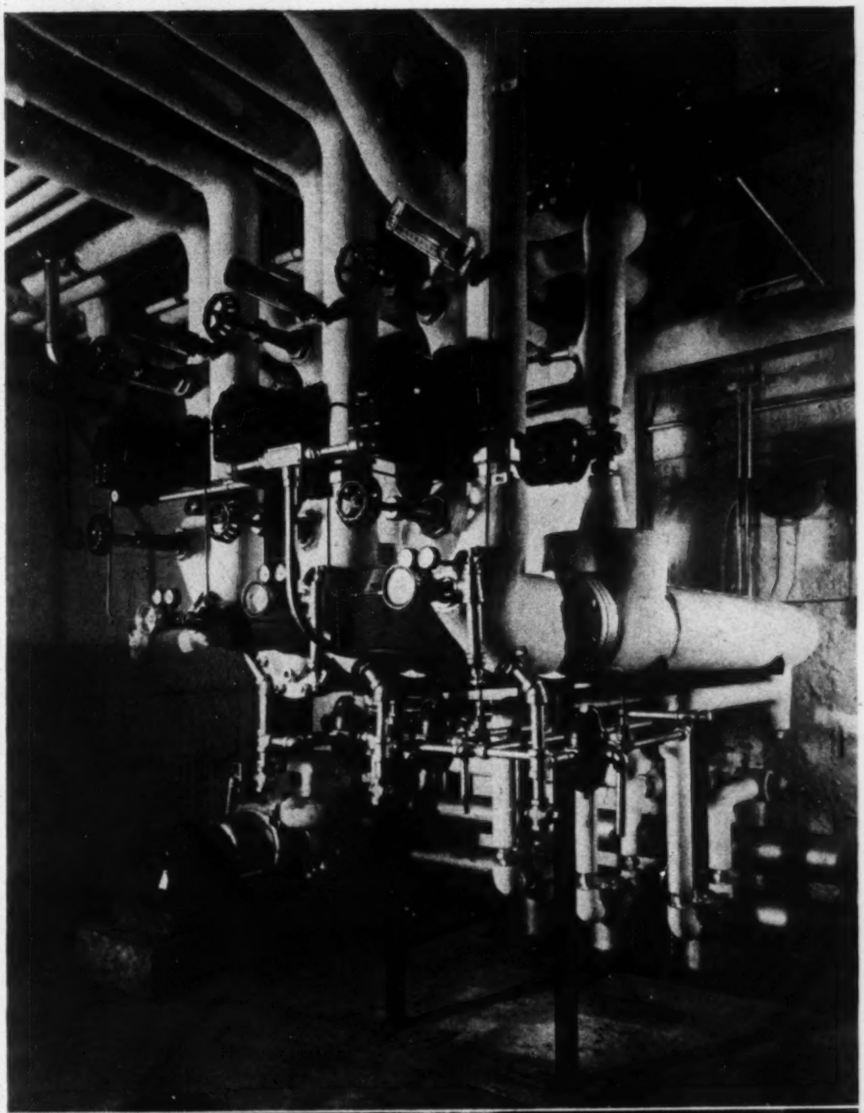
In order to heat, cool and ventilate the building, two supply fan systems were installed, one with a capacity of 12,500 cfm and the second with 10,500. Each system recirculates part of the air. The balance is taken from the outside where it is passed through an electric precipitator, preheating coils, humidifier, and then to the fan where it is carried to a large plenum chamber. From this plenum chamber individual ducts are carried to each room and each individual duct system is provided with a separate booster coil and a cooling coil. The room booster coils are two row and the cooling coils are eight row, water type, double serpentine.

Fig. 1 shows the general arrangement of the large plenum chamber with ducts going to each individual room, and it will be noted that two control valves are provided for each duct so that while one room might be calling for heat, another room might be calling for cooling.

Hot water converters are used to furnish hot water to the coils by means of a circulating pump. There are two converters that are used in connection with the preheating coils, one converter for each system with a separate circulating pump. The room booster heaters are furnished from another converter with a single pump.

Germicidal lamps have been installed in the fan discharge so as to kill all forms of bacteria before the air is delivered into individual rooms.

In addition to the supply fans, there are installed on the roof five mechanical exhaust ventilators. These exhaust ventilators are used for removing air from the toilet room systems, the lunchroom, and also a certain portion of the air in most individual offices, laboratories, etc. In general, air is supplied in laboratories, etc., in the upper part of the room, and the recirculating connection from the room is taken off the opposite side of the room from the floor. A separate exhaust



Top: Fig. 2—There are two converters supplying hot water to the preheating coils—one for each supply fan system —and the room booster heaters are supplied from another converter with a single pump, as illustrated here. Bottom: Fig. 3—A new 50 ton capacity steam jet refrigerating machine was installed and the capacity of the existing machine was increased. This type of refrigeration proved most economical in this case, for a high pressure boiler plant provides steam for process work, and for plant heating in the winter. It was therefore desirable to build up the summer steam load

connection is taken out of the room at the ceiling of the opposite side from the supply, an arrangement which makes it impossible to unbalance the air conditioning system.

How System Is Controlled

A thermostat located in each room controls the room temperature through gradual control of chilled water and hot water flow valves on the cooling and booster coils for that room. The preheater coils are controlled by a duct thermostat on the leaving side of the fan which regulates the steam flow to the preheat converter and also stops the circulator pump when heat is no longer required.

In summer a room type hygrostat located in the general office opens and closes the chilled water valves on all the room cooling coils simultaneously as the humidity in the general office rises and falls. This control is for one fan system. A similar control set-up with the hygrostat in one of the other rooms controls the other fan system. The action of this control, however, does not interfere with the action of the various room thermostats.

In winter the hygrostats mentioned above control a grid type humidifier in the inlet of each of the supply fan systems. The refrigeration machines are controlled by two immersion thermostats in the chilled water header through four pressure switches, each of which operates a steam valve to one stage of refrigeration.

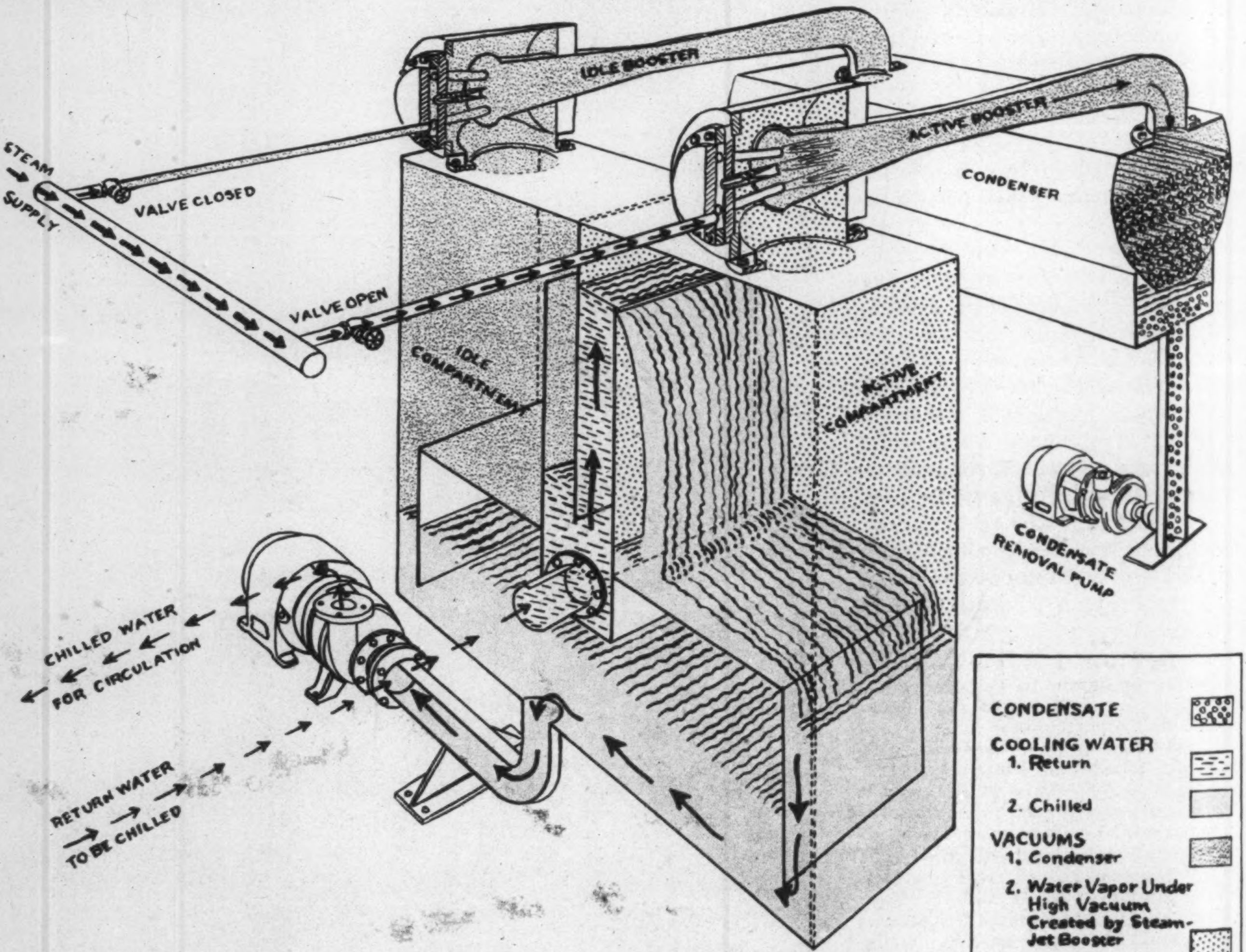
Steam Jet Refrigeration Used

The air conditioning system utilizes steam for cooling through the medium of steam jet refrigeration machines. National Aluminate was one of the first concerns to take advantage of this type of system. A large high pressure boiler plant provides steam for process work, and for plant heating during the winter, but these boilers were operated with minimum loads during the summer. It was found very economical, in this case, to build up the summer steam load and provide steam jet cooling circulation. Thus the refrigeration cost is, in reality, only the actual cost of fuel required to produce the extra steam.

One new 50 ton steam jet unit (see Fig. 3) was installed and the capacity of the existing machine was increased to give maximum capacity for the present condenser. The capacity of the steam jet machines is 125 gpm each when cooling water from 58 to 48 F with 350 gpm of condensing water available at 84 F or less and utilizing steam at 100 psi pressure.

The new machine is cross connected with the existing machine so that the entire cooling load can be picked up in four steps as load conditions require. This capacity change is accomplished automatically through application of pneumatically operated thermostat and valve equipment.

Fig. 4—This drawing illustrates the principle of operation of the steam jet refrigeration, which is further explained in the text


IDLE BOOSTER
ACTIVE BOOSTER
STEAM SUPPLY
VALVE CLOSED
VALVE OPEN
CONDENSER
IDLE COMPARTMENT
ACTIVE COMPARTMENT
CONDENSATE REMOVAL PUMP
CHILLED WATER FOR CIRCULATION
RETURN WATER TO BE CHILLED
CONDENSATE
COOLING WATER
1. Return
2. Chilled
VACUUMS
1. Condenser
2. Water Vapor Under High Vacuum Created by Steam-Jet Booster

One new cooling tower was installed and one existing tower was rebuilt to increase its capacity to the same as the new tower. The towers are conventional type, redwood filled, induction draft cooling towers, approximately 15 ft wide by 16 ft long and 25 ft high. Capacity of each tower is 350 gpm, cooled from 94 F to 82 F when the prevailing wet bulb temperature is 75 F. Condenser water circulating pumps take their suction from a common line, but each pump has a separate connection to return the water to its cell of the cooling tower. Piping is so arranged and valved that it is possible to have either tower serve either refrigeration machine.

The circulating water which passes through the condensers is carried out and cooled through a cooling tower to remove the heat of condensation, and it is then reused through the refrigeration unit condenser.

How a Steam Jet Unit Functions

As a matter of explanation, the principle of the steam jet refrigeration unit is based upon the temperature of water assuming boiling temperature at a vacuum pressure; for example, 29.66 in. mercury vacuum is equivalent to 48 F water. In other words, any water entering the evaporator of the steam jet refrigeration unit above 48 F would begin to boil and then drop in temperature until it reaches 48 F. The vacuum will then be 29.66 in. mercury. The chilled water then becomes the refrigerant in the cooling system (see Fig. 4).

Steam jet boosters are used to produce the vacuum pressure in the evaporator. The motive power for producing the vacuum in the evaporator is steam through boosters and ejectors, which remove the vapors produced by the boiling of the returned refrigerant (water in this case) from the cooling coils. This returned refrigerant from the cooling coils, being above the desired temperature for cooling, must be boiled to reduce its temperature. The cooled water is then called the chilled water, or refrigerant, and is used in the cooling coils.

The chilled water, or refrigerant, referred to above is removed from the evaporator by a centrifugal pump and delivered to the various coils which regulate the room temperature and humidity.

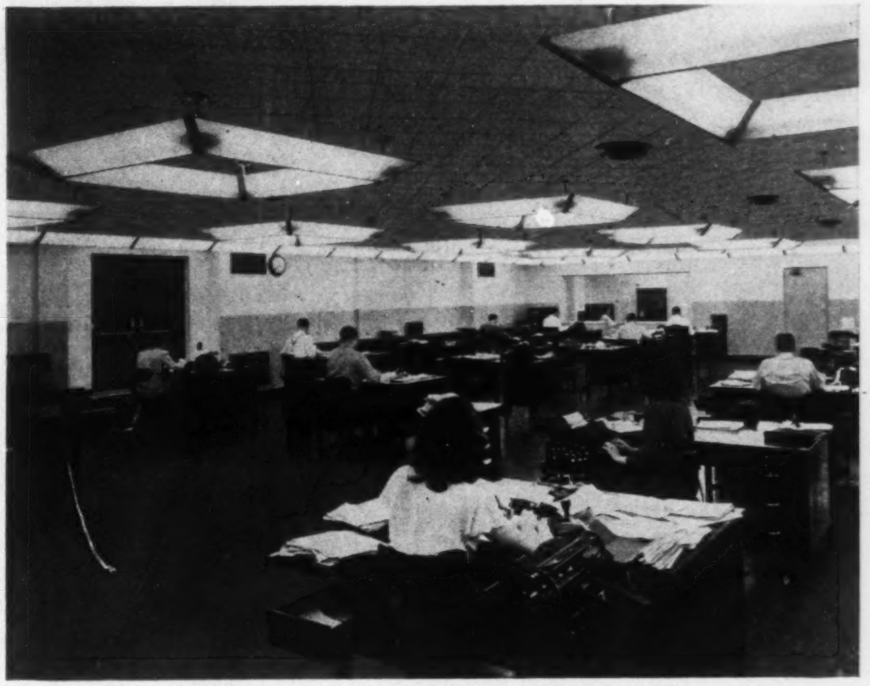


Fig. 5—This view of one of the two large offices shows the special rectangular type of fluorescent lighting fixture used throughout

On hot, humid days the steam jet refrigeration unit characteristics are such that it will give a very large overload capacity. This means that the cooling down period is reduced and peak loads are easily handled. It is impossible to strain or damage a steam jet refrigeration unit by any overloads.

Economical part load operation is obtained on this unit by using automatic boosters which are cut in and out depending upon the refrigerating load required to cool and dehumidify the air in the building. The control of the refrigeration unit under all load conditions is very simple and automatic. Steam and water are automatically controlled by the temperature of the chilled water leaving the evaporator.

Cooling water through the condensers is treated to eliminate scale and slime deposits forming on the condenser tubing and this practice has proven very effective in eliminating loss in heat transfer.

Schmidt, Garden & Erikson were the architects and engineers for this project, the ventilating contractor was Narowetz Heating & Ventilating Co., and the piping was installed by Northern Plumbing & Heating Co.

[Photos by Hedrich-Blessing Studio]

CONDENSING UNIT STANDARD PROGRESSES

Representatives of a dozen leading corporations in the refrigeration field reported progress last month in the creation of a set of minimum standards for open type condensing units up to and including 5 hp in size.

There were indications that the standards could be completed and approved before the end of 1947, following another meeting of the industry joint engineering committee at Swampscott, Mass. Bringing together men from both the Air Conditioning & Refrigerating Machinery Association and the Refrigeration Equipment Manufacturers Association, the Swampscott session was "the second in history at which representatives of groups covering the entire refrigeration machine industry were able to meet and work in complete unity for a common purpose."

At Swampscott the committee members had before them a preliminary draft of the new set of minimum standards. They spent an entire day going over them, item by item and paragraph by paragraph. In their revised form the standards will be sent to all interested parties for further comment or approval. A third meeting of the committee will then put the standards into final form.

Design Engineer Reports on Operating Experience

PRACTICAL PIPING PROBLEMS

Our trip to Sydney, Australia, from Abadan was as eventful as the previous leg—if not more so. This was another long stretch (24 days), and it seemed as if something were happening most of the time. Two things had us on edge—the fact that we still had only one useful feed pump, and that it was in an unknown condition; and the fact that our two fuel oil service pumps were in poor shape and were getting worse every day. The fuel oil we had taken on board at Abadan was none too good in that it had a high viscosity, a high flash point, and contained a very considerable quantity of sand and vegetable matter. So trouble was to be expected.

Our first emergency was a rather amusing and peculiar one and happened even before we got out of the river and into the Persian Gulf proper. We were operating at 70 rpm, which for navigating in this channel was full speed. We were expecting to reach the gulf soon and thus expected to receive a call from the bridge to increase the speed to the normal 88 rpm. When the "phone finally rang," they wanted full speed all right. But the mate sounded slightly hysterical, and asked for all power possible.

I opened the throttle wide— with almost negligible results. We knew something was wrong somewhere but weren't sure what it was. Fortunately, the first engineer was also in the engine room (as he should have been during maneuvering) so we were able to do all possible to increase the power. The steam pressure in the meantime dropped from 450 to less than 400 psi and we were again laying down a smoke screen. In view of our past oil troubles, we suspected that that was a contributing cause, so we increased the oil temperature by opening up more on the bunker and oil heater coils. But still it didn't seem to help much. In about five or 10 minutes we got a signal for half speed and were able to catch up and straighten out the plant.

That noon we found out what had happened. It seems that we hit a mud bar in the narrow delta channel going out into the Persian Gulf. Supposedly, we had about a foot clearance for our draft but evidently someone miscalculated for we literally dug our way through. The boys on deck said that great chunks of mud were coming up to the surface and that the ship slowed almost to a standstill. However, we did make it, and there was some satisfaction in knowing that we must have made it easier for the next loaded ship. It was no wonder that we were unable to get up to higher than 80 rpm, and it was a miracle that we got up that high. After all, the ship wasn't built for dredging service.

About a week out from Abadan, the cabin boy became seriously ill, apparently from appendicitis. We radioed for help and headed for the nearest port, Bombay, India. We came into the port in the morning on a beautiful clear day and got a good enough view of that enormous harbor to appreciate its possibilities

JOHN H. CLARKE, the author of this article, wanted to get information on the problems with piping systems, pumps, valves, heaters, control and other mechanical equipment faced by the operating man . . . how designs perform in actual service . . . how equipment is actually operated. The answers to these questions were among his objectives when he (a marine design engineer by training and profession) shipped on a tanker as junior third assistant engineer. By the time his seagoing phase was completed (he's now back on land as a design engineer with the Standard Oil Company of Indiana) he got plenty of practical information on piping, pumping, heating, ventilating, and other subjects. His comments and observations on much of his experience are continued here from our November issue. A lot of what he found out applies not only to marine work but to the design, operation, and maintenance of mechanical equipment in plants and buildings as well.

and the size of the city. We had a difficult time contacting the pilot boat, and when we did they raced for us like mad, waving their arms and shouting. We soon learned that we had drifted in too far and were in danger of grounding here also. So we went full astern for about five minutes in order to bring the ship to a stop, and to back it out of danger. Again we must have moved several tons of sand in the process. And while we didn't hit the bottom, we must have been close to it.

A port physician came out in a crash boat and confirmed that the cabin boy was stricken with appendicitis, so he was taken ashore to be hospitalized. We hoisted our anchor and were soon on our way again. The only aftermath of this incident arose about a thousand miles (*actually*) out to sea when it was discovered that someone had neglected to pull our starboard anchor all the way up, and that it was hanging over the side and flapping in the breeze. A loose anchor can be serious in even a moderate sea, so we stopped right out there in the middle of the ocean and hauled it up.

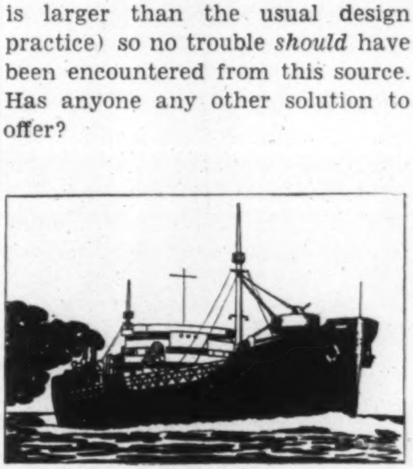
Serious Fuel Oil Pump Trouble

We experienced serious fuel oil pump trouble practically all the way to Sydney. For several weeks, hardly a day went by but what a pump failed. This reached the ultimate on one of my watches when one pump suddenly failed, the fuel oil pressure dropping to 100 psi. The standby pump was put into service and the chief was immediately called to check the pump that had failed. He arrived just about the time the second pump failed. So both pumps were operated in parallel. This held the pressure up to 150 psi for another five minutes and then the pressure took another nose dive to between 75 and 100 psi, and we had to work fast.

The chief and the second engineer attempted to start a large capacity fuel oil transfer pump, which had a discharge cross connection to the fuel oil service system. This pump was supposed to be for low pressure service and its relief valve was set at 125 psi, but we hoped it would at least keep us going for awhile. It was first started on high speed, and the relief immediately popped—so it was shifted to low speed. This was soon followed by the unmistakable odor of burning rubber and varnish. The pump was promptly stopped. In the meantime, the pressure had returned on the regular fuel oil service pumps about as mysteriously as it had disappeared.

A check of the transfer pump starter box showed that no damage had been done by the overheating, which had been caused by the fact that when the pump was shifted from high to low speed, the mechanical interlock failed to de-energize the high speed coil, so that both coils had been energized at once.

As for the peculiar manner in which the fuel oil service pumps lost and recovered their pressure, I have heard only one logical solution to *that* phenomenon. That is that the pumps must have picked up a considerable amount of sludge from the bottom of our fuel tanks, and that this oozed through the suction line and strainer so slowly that it would be much the same as if the suction valve were almost closed. This may have been the case, inasmuch as the high slip caused by the worn pump casings of these screw type pumps would have made such a situation possible. However, I distinctly remember checking the pressure loss across the strainer under these circumstances and this was normal at all times observed. There *is* a possibility that the strainer gage lines were plugged, and that the gages were not registering correctly; this has happened frequently. The suction strainer was clean, and was being cleaned once a day. The basket of the strainer was provided with 3/32 in. diameter holes (which is larger than the usual design practice) so no trouble *should* have been encountered from this source. Has anyone any other solution to offer?



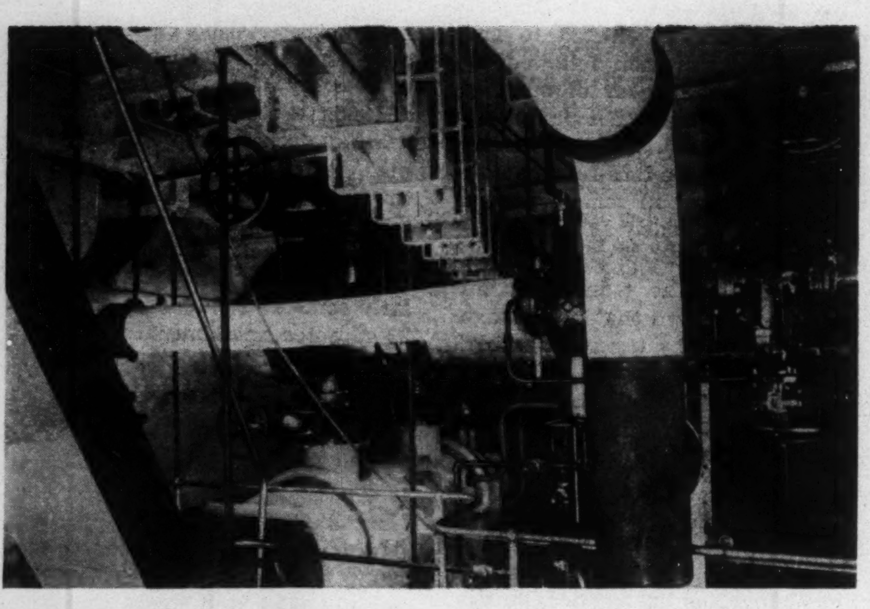
As an interesting offshoot of the above troubles, it should be noted that every time we required an additional steam load for cargo heating, deck steam, "Butterworthing" (tank cleaning), or blowing tubes, it was first necessary to slow down the ship so as to stay within the fuel capacity of the pumps. For soot blowing we now had a regularly scheduled slowdown for about 20 minutes each morning.

Excessive Clearance Causes Feed Pump Failure

Along with our fuel oil pump troubles, we were also having considerable trouble with the feed pumps. The forward main feed pump, (turbine-centrifugal) was again tested and again failed to develop more than 300 psi. Around 500 psi was necessary for feeding the boiler. The top casing and the rotor were then removed for a more thorough inspection of the pump. This revealed that the pump thrust bearing shoes on the aft side had fused and were practically nonexistent *as bearings*. The journal bearings were also worn, and were replaced when the pump was finally repaired at Sydney.

Interstage cutting was still given as the reason for the pump failure. No such cutting was observed by me, and it was my opinion that the failure of the thrust bearings had increased the vertical clearances of the casing wearing rings at the impeller. A subsequent talk with a representative of the pump manufacturer convinced me, however, that the actual reason for the failure of the pump was that when the journal bearings had failed on previous occasions, the dropping of the shaft wore the casing wearing rings into an oval shape. The excessive clearance eventually became great enough to cause the pump to fail.

The failure of these pump bearings (and the turbine bearings as well) could not be attributed to lack of oil. The oilers saw to that, in their own inimitable manner. At least twice a watch (there were four hours to a watch) they were pouring a pint of oil through each bearing in an attempt to drain out the "water" in the bearings and also to cool them off. Of course this did cool them off temporarily, but I doubt if they got rid of much water; it never got a chance to accumulate.



This photograph of a similar ship shows a view of the lower machinery spaces, looking aft from the compressor flat. The large handwheel in the upper right is the one that came off as the oiler was turning it, thus causing a serious fall. To reach the valve, it was necessary for the oiler to stand on the platform guardrail, shown near the bottom of the picture. Such a requirement certainly did not contribute to safe operation of the equipment

What they mistook for water in the oil was actually air, emulsified in the oil, thereby giving it a whitish color. The above procedure resulted in our collecting a 42 gal drum of "waste" oil every two to three days, this oil then being pumped overboard to dispose of it. As soon as the chief discovered this, he clamped down on the oil usage, but he was never able to cut it down to a normal amount or to convince the oilers that their procedure wasn't correct. Each oiler had learned from his predecessor and *he knew*.

Bearings Overpacked with Grease

This same type of inherited experience also accounted for the excessive overpacking of the pump ball bearings with grease, and for the greasing of the main circulating pump shaft with ordinary chassis grease in lieu of the proper grease for salt water service. We had trouble throughout the trip with this sort of thing, and the only way it was ever licked was to restrict all greasing to two men—the electrician for the motors, and the third engineer for all other engine room equipment. Of course, this should have been done in the first place.

In order to give us some measure of safety for the rest of the trip to Sydney, the reciprocating auxiliary feed pump was now checked to see if we could get it into service for an emergency. The valve chest was opened to determine the cause of the valve leaks and it was found that the suction discs were seriously pitted and were seating improperly. The valves were then all ground in until a tight seal was obtained and then the pump was tried out to see if we could operate with it at reduced speed.

It worked moderately well for awhile, and then a gasket blew out on the valve chest cover plates. New gaskets were provided and these also blew out or leaked after a short while despite repeated tightening of the cover bolts. Finally, we developed a serious gasket leak and sprayed the whole lower engine room opposite the pump with water. The aft main feed pump was secured at the time, so it was necessary to work fast to get it started and to prevent losing the water in the boiler.

Fortunately, the water that was sprayed around did not strike any electrical equipment so we escaped from this incident without damage. However, the sponsors of drip-proof motors should note that in any power plant, water which might damage equipment does not always conveniently come from above.

The gasket material which was used for the valve chest covers was of a type specifically recommended for high pressure, hot water service. However, we could not keep them tight, and our problem was solved only when we resorted to the use of copper gaskets. These did hold, perfectly. With the auxiliary feed pump at least usable, the aft main feed pump was shut down long enough to flush out the bearing wells and to repack the trip-throttle valve. We then prayed that it would last at least until we got to Sydney—almost two weeks away.

Heat Exchange Tubes Fouled Up

We were having considerable difficulty with our heat exchange equipment on this trip because of the fact that the tubes had become fouled up with the heavy silt of the Shatt al 'Arab River. No general attempt was made to correct this condition, but finally the lube oil temperature got so high on our outboard auxiliary generator that we shifted to the inboard unit, in order to clean the cooler on the outboard unit. These coolers were very small, less than a foot long, and were designed with 3/16 in. tubes which were rolled into the tube sheets and cut off. The projection of the tube ends did much to increase the fouling, and it seemed odd that at least the entrance ends had not been beaded at the first and at the return passes. Larger tubes would certainly have been better; as it was, about two-thirds of the tubes were completely plugged, and many more were partially plugged. In any case, the coolers were too small in capacity and it had been necessary to operate with about 25 psi water pressure to the tubes, in lieu of the 5 to 10 psi for which the cooler was designed, in order to get proper cooling.

In shifting over the generators (as mentioned above) the cooling water was not turned on for the inboard generator cooler. The change-over was hurried as it was the end of the third engineer's watch, and apparently he overlooked opening the cooling water valve. The second engineer did not check the equipment when he came on watch so he did not notice that the water was turned off. By the time the second engineer finally discovered the oversight, the cooling water had been off about an hour and a half and the lube oil temperature at the cooler inlet had risen to 195 F. What the bearing temperatures were we didn't know, as we had no bearing thermometers; but they must have been plenty hot. We were extremely lucky that we didn't damage the bearings under the circumstances.

Valve Handwheel Comes Off

Another incident that occurred during the above auxiliary generator change-over is worth noting. The oiler on watch went below to open the exhaust valve on the inboard generator. To do so, it was necessary to stand on a platform guardrail and hold on to the valve handwheel at the same time as it was turned. Such a procedure is not in the category of safety—but for this valve arrangement (poor as it was) it was necessary to do so. In turning, the handwheel came off, and the oiler fell backward down onto the platform, the heavy 16 in. cast iron handwheel falling on top of him. It was a miracle that he was not seriously injured. But again this pointed to the necessity for seeing to it that all handwheels are properly secured so that they cannot come off accidentally. This may seem like a small point, but it is often overlooked, and serious accidents *can* result.

Up until a few days before arriving at Sydney we had no more serious trouble and aside from usual fuel oil pump difficulties and a few other interesting incidents the engine room was reasonably quiet.

One of the two gland studs on the 125 hp main circulating pump broke off after having corroded away from ¾ in. to about 5/16 in. diameter. The steady low frequency vibration of the pump evidently completed the job. The stud couldn't be replaced because there was no way of getting at it adequately for boring it out without special tools, or else removing the large motor over the pump (this was a vertical centrifugal, double inlet, low speed pump). For this reason no repair was made on the pump and it leaked profusely for the entire journey—all the way back to our final destination in the United States.

We had been having some trouble with arcing on the slip rings on the main generator and although the electrician kept the rings well polished and in excellent condition, we still had trouble. Part of it was that the slip rings were slightly eccentric with the shaft. The other reason was that the slip rings were only covered on the top (not totally enclosed) and we were never able to convince the wipers that, when sweeping up, it was of the utmost importance *not* to raise a dust cloud *—particularly around the slip rings.*

The current to these rings was about 580 amps at 120 volts. In any case, we had had several cases where there had been momentary arcing at the brushes but this had soon disappeared and the rings had been immediately cleaned up to keep them in good condition.

But one morning the second engineer reported trouble on his watch and it looked as if we were in for more. I reported for my watch half an hour later and hadn't been on duty five minutes when things really broke loose. It sounded like a machine gun barrage. This time it was necessary to stop the ship to de-energize the slip rings, and to change three of the seven brushes. The electrician stated that under the existing conditions the brushes had been lasting a maximum of five months. We had been out from Baltimore at this time about three and a half months, and the brushes had been changed at Baltimore.

Small Gage Lines Break

We also had a rash of broken gage lines along about this time. Among others, one on the main circulating pump broke between the valve and the nipple on the large discharge pipe. One on the auxiliary circulating system broke following the gage valve. Both were immediately repaired, the first, of course, with the line under pressure. We couldn't shut down for that small an item, and the discharge pressure of the main pump was generally less than 10 psi, so it was not a difficult repair.

Part of the gage trouble could have been eliminated by the use of substantial nipples for the gage lines. All of ours were ¼ in. The practice of many engineers now is to use a minimum of ¾ or 1 in. size with an extra heavy wall. That would have helped considerably on this ship because the main contributing cause was vibration, which you never get away from on a ship. But probably the main cause for the above gage lines breaking was that the circulating pipes were of copper, the gage lines were of steel, and the cooling water was, of course, sea water.

Repacking a Pump

We were having considerable gland leakage from our salt water and sanitary pumps (actually, the salt water pump was a standby for the sanitary pump and vice versa). The second pumpman was delegated to the task of repacking the glands. He *really* did a job on the pumps. Someone had told him at one time or another that you should pack a gland hard and then back off on it after the pump was running.

I was finally sent down to check the job on the sanitary pump and arrived just shortly after the pumpman had started the pump (which he should not have done, incidentally). The odor of burning packing was readily discernible, but this didn't seem to disturb him. The salt water pump was immediately started, and the sanitary pump stopped and examined. The second pumpman had taken up on the packing gland as hard as he could until it was jammed absolutely tight. It is difficult to understand how the pump was ever able to start up at all. Even after backing the gland clear off, loose, the packing didn't back off and loosen up and it was necessary to pull it back. It was later tightened "finger tight" by the first engineer and it operated properly thereafter.

STAINLESS STEEL PIPING—SELECTION OF PIPE JOINTS

In the article on Stainless Steel Piping—Selection of Pipe Joints, by J. D. Mattimore, which was published in the November HPAC, a statement in the left hand column on page 86 is incorrect in regard to the flow of current in a battery. Actually, two different metals in the presence of an electrolyte—any liquid capable of carrying an electric current—set up a small battery with the current flowing *from* the less noble metal, the anode, *to* the more noble metal, the cathode. The anode is gradually dissolved and may eventually disappear.

G. E. CLANCY, physicist and consulting engineer to Drayer-Hanson, Inc., of Los Angeles, explains here various methods for using groundwater as a heat supply or heat disposal means without pumping it from a well. He concludes by describing an interesting method involving steel splines on the well casing which are caused to spread out into the ground to promote heat transfer; this scheme has been used with a 5 hp reversible cycle (heat pump) unit conditioning a group of offices in a factory. In the November HPAC, Mr. Clancy described various types of supply and disposal wells and gave practical pointers on their construction and operation

HOW TO USE GROUNDWATER Without Pumping It from Well

Since it is primarily desired in air conditioning and heat pump installations only to transmit heat to the groundwater (hence the ground) or to extract heat from it, it is not entirely necessary to remove the water from the ground to do so—though, of course, in some cases this may be the most convenient, economical, or expeditious procedure.

There are several possible situations and solutions:

1) A shallow well containing surface water at a suitable temperature and a high level—there may or may not be a lateral flow.

2) Water in a rather deep well—at suitable temperatures but at too low a level for economical pumping.

3) A well, usually shallow, which would not develop a sufficient quantity of water but the ground does contain enough water to more or less saturate it.

4) The well may be in ground which is only moist or even in dry ground.

In Case 2, if there is a very pronounced lateral flow and the casing is well perforated, we might submerge a heat exchange element such as a coil of pipe below the level of the water in the well and circulate a secondary heat transmission vehicle through it. Unless the temperature in the well or the temperature of the pipes to and from it may fall below the freezing point of water, water is best suited for this work. Salt brine, calcium chloride brine, ethylene glycol solution, or alcohol solutions are among the possible vehicles which would tend to resist freezing.

In all of the cases the well might be left unperforated and the bottom plugged. Then the well would be filled to the surface, closed off, and the vehicle circulated within and through it.

Any of these systems have a definite advantage in pumping energy required as it is only necessary to circulate the water or other vehicle at sufficient head to overcome frictional losses. The water or other vehicle circulated is free from scale forming salts and by treatment may be made noncorrosive.

However, the final heat transmitting element in contact with groundwater may still form scale, but the conditions are not as conducive to it as when the water is taken out and used.

Possible Methods to Employ

In any of these cases the problem now becomes one of heat transmission more than water development. Let us consider some possible methods.

Referring to Fig. 1, a well is drilled and cased to a considerable depth below the water level—per-

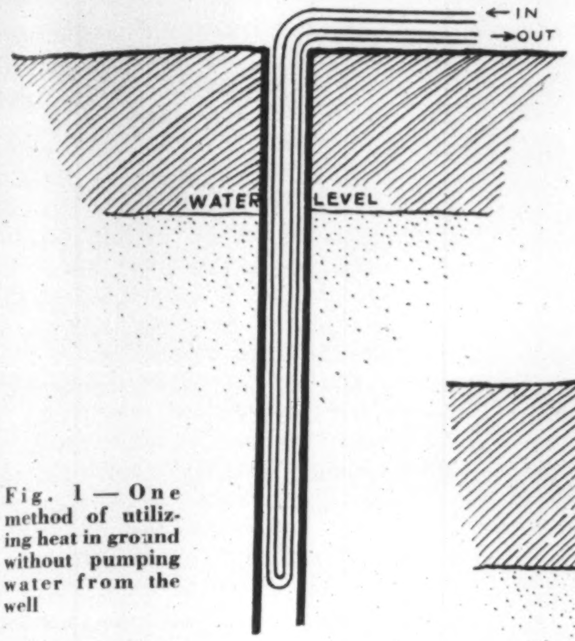
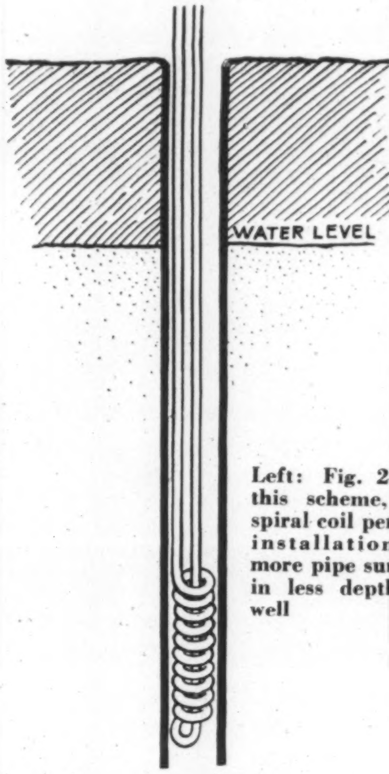
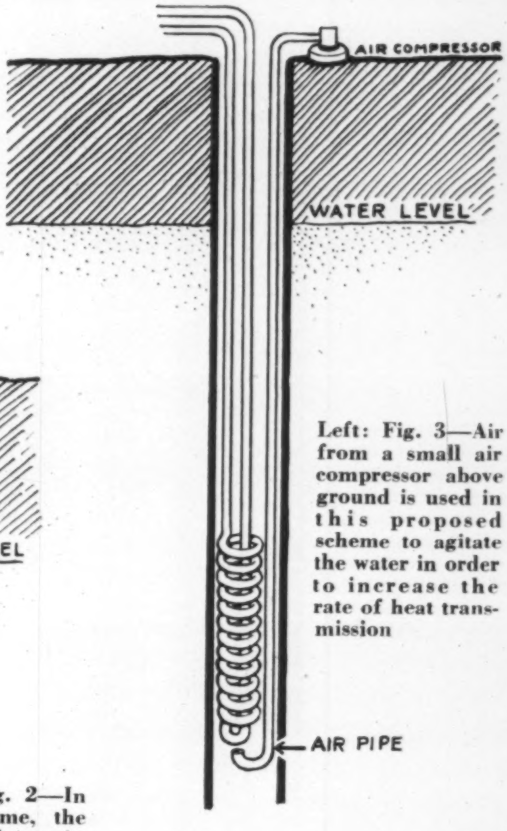

← IN
→ OUT
WATER LEVEL

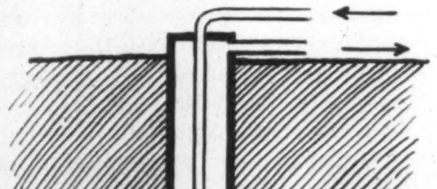
Fig. 1 — One method of utilizing heat in ground without pumping water from the well


WATER LEVEL

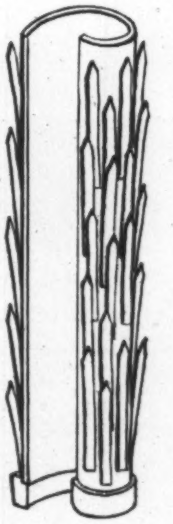
Left: Fig. 2—In this scheme, the spiral coil permits installation of more pipe surface in less depth of well


AIR COMPRESSOR
WATER LEVEL
AIR PIPE

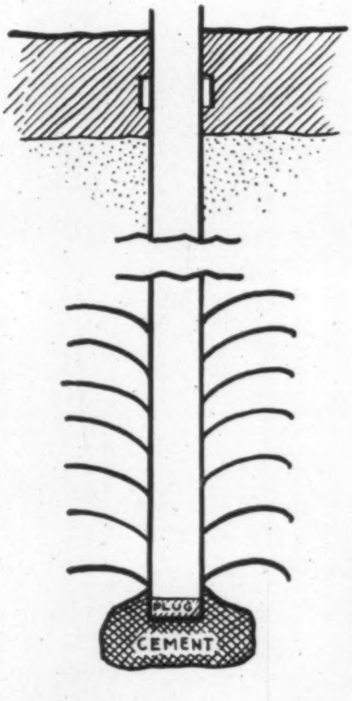
Left: Fig. 3—Air from a small air compressor above ground is used in this proposed scheme to agitate the water in order to increase the rate of heat transmission


WATER LEVEL
PLUG
CEMENT

Above: Fig. 4—If the secondary loop is omitted, the well sealed off, and water circulated in the blanked off cased well, one heat transmission stage is avoided

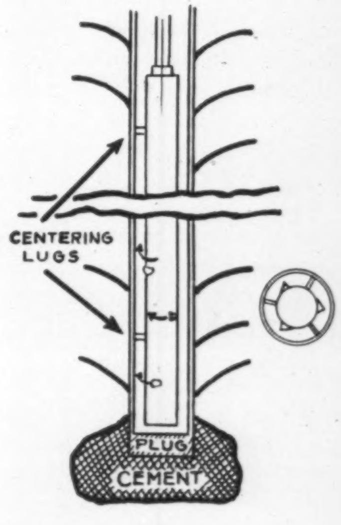


Right: Fig. 5—To improve heat transfer between the casing and the surrounding ground, steel splines are affixed to the lower part of the casing. They look this way while the casing is being driven into the ground


PLUG
CEMENT

Left: Fig. 6—After the well has been drilled and cased, the casing is raised a short distance by hydraulic jacks. The splines catch in the ground and project outward, forming heat conducting members

Below: Fig. 7—A pipe is run to the section with the heat conducting splines, where it is equipped with nozzles to cause rapid water circulation over the inside wall of this section of the casing


CENTERING LUGS
PLUG
CEMENT

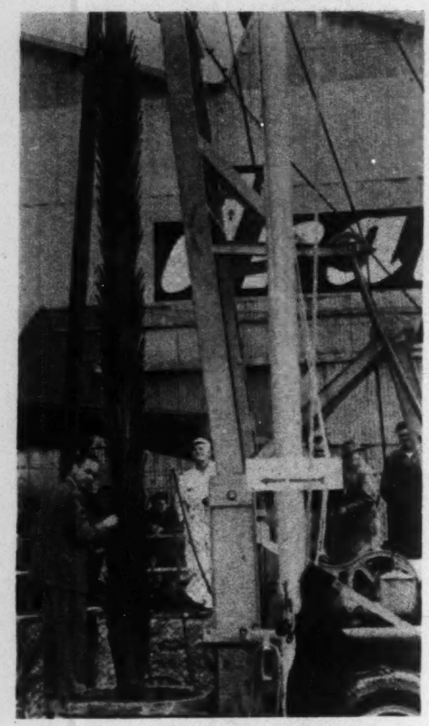


Fig. 8—The splined section of the casing about to be driven. This well serves a 5 hp reversible cycle (heat pump) unit conditioning a group of offices in a factory building. The photo on the front cover shows the welding on of the splines in the shop

haps 150 to 200 ft (if the water bearing stratum is that deep). A loop of pipe is suspended in the well. The bottom is left open; the casing may or may not be perforated below the water level. If there is a strong lateral flow the former is most likely advisable. Also, if the water bearing stratum is coarse sand or gravel, perforations may aid in thermo-siphon circulation within the well.

Here the rate of heat transmission from the water in the well to the pipe will be quite low because the water in the well is at best moving sluggishly, even though the rate of movement of water through the ground surrounding the casing is considerable (which it usually is not).

The well casing, having more exposed surface than the pipe loop, need not transfer heat as rapidly.

It is necessary to transmit the heat from the circulating fluid to the pipe wall, through the pipe wall, into the water in the well, through the water in the well to the well casing, through the casing, into the water surrounding the casing, and thence to the surrounding ground. One of the very first stages (carrying the heat away from the pipe loop) transmits heat at a low rate per unit of surface, and this is one of the smaller surfaces in the process even though the well is quite deep.

A spiral coil, Fig. 2, might be used which would permit the installation of more pipe surface in less depth of well.

Because the rate of heat transmission both to the inside of the casing and the outside of the pipe coil or loop is low—and hence likely to be a critical factor in the overall performance—the water should be agitated. Mechanical agitators or pumps are usually impossible or impractical. The author proposes to create the desired agitation by running a small pipe to the bottom of the well through which air is forced by a small air compressor located above ground [patent applied for], as indicated in Fig. 3.

If the secondary loop is omitted (Fig. 4), the well sealed off at the bottom and not perforated, and water is circulated in the blanked off cased well, one heat transmission stage is avoided. All of the casing—even that above the water level—will transmit some heat. The circulating system and its pipes may be arranged so that jets may be used to cause a good rate of circulation of the water within the casing.

Casing With Splines Aids Heat Transfer

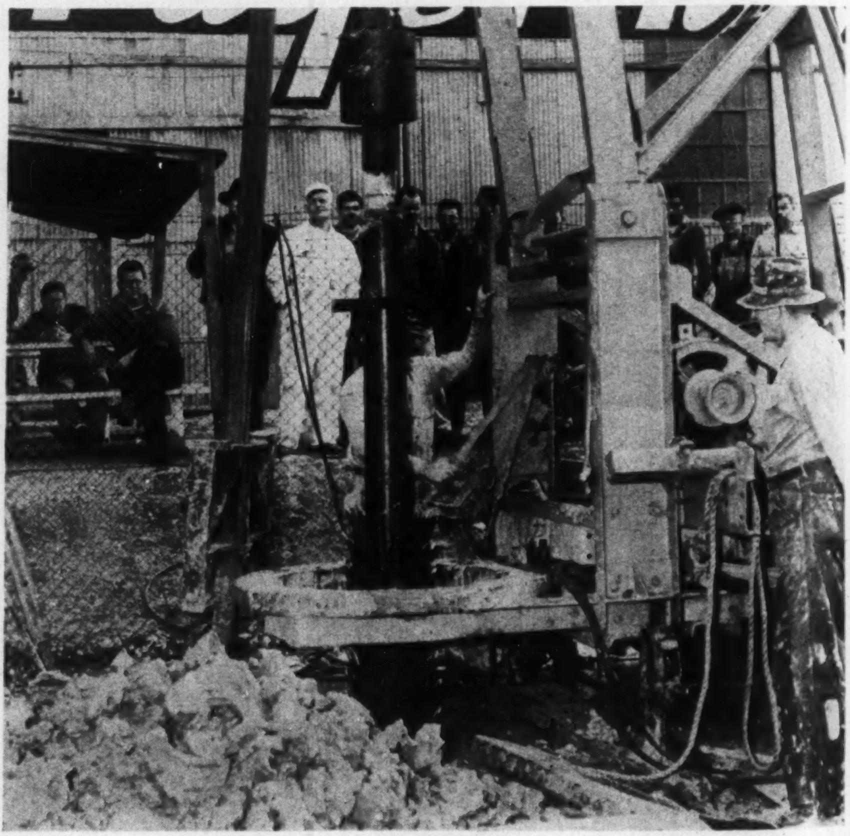
The author has devised and reduced to practice apparatus and a system [patent applied for] which overcomes most of the difficulties of the foregoing schemes.

A section of well casing (pipe or other pipe-like well casing) is provided with splines which are fixed at one end to the casing (welded, brazed, or riveted). These splines are flexible and overlay one another row upon row, each extending in an upward direction from the end affixed to the casing, as shown in Fig. 5.

A well is driven with the part of the casing having splines affixed to it sunk into the water bearing stratum, or in some cases only into moist or even dry ground. The part above is cased with plain casing of the same size as the splined section. Joints may be either welded or screw coupled.

Because the splines lay flat against the outside of the casing the

Fig. 9—In this view, the splined or spiked section of the casing has almost disappeared into the ground



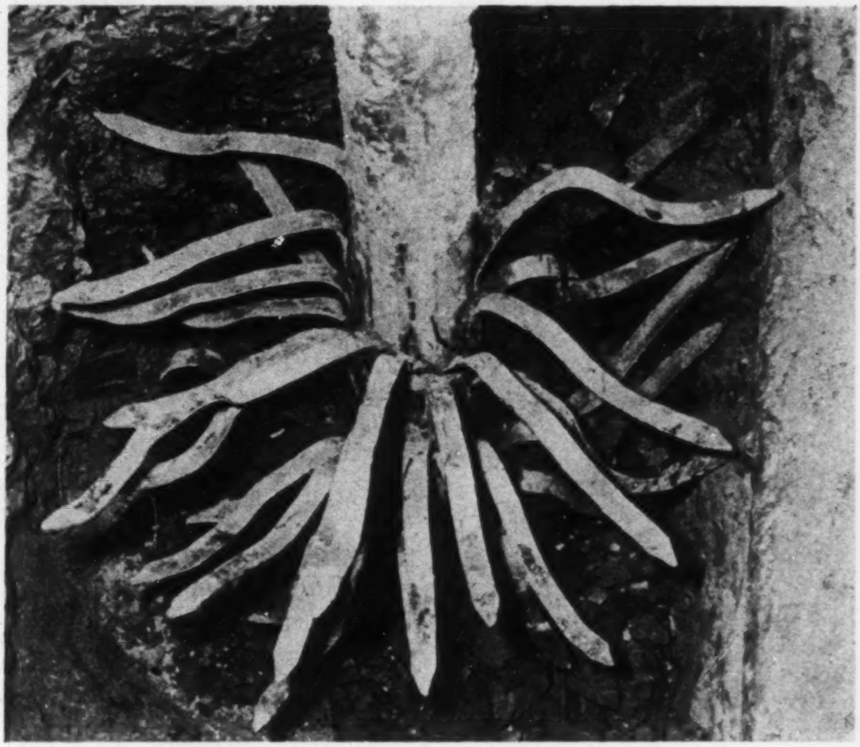


Fig. 10—This picture shows what happens to the splines after the casing has been raised a short distance by hydraulic jacks to spread them out into the surrounding ground so that they will form heat conducting members. This was a test job which was driven and then excavated to see how the splines behaved

casing may follow the downward progress of the drilling tools in the same manner as plain casing.

After the well has been drilled and cased, the casing is raised by hydraulic jacks a short distance. This causes the splines to catch in the ground around the well and project outward, Fig. 6, forming heat conducting members which extend into the ground radially from the casing. The bottom of the well is then sealed off (plugged).

A pipe from the system is run to the section provided with heat conducting splines where it is equipped with nozzles which cause a rapid circulation over the inside wall of this section of the casing (see Fig. 7).

A well of this type was sunk at Los Angeles to supply heating or cooling effect for a 5 hp reversible cycle (heat pump) unit which delivers about 60,000 Btu per hr for conditioning a group of offices located within a factory building. The operation has been quite satisfactory with a maximum variation of about 15 F between the ground temperature and the delivered water temperature.

The well is 57 ft deep, cased with 6 in. pipe having a ¼ in. wall thickness. The bottom 15 ft is provided with 600 spikes of ¼ in. x 1 in. mild steel about 12 in. long. The ground is a clay-like formation of decomposed shale. The location is not suitable for water development.

The water level was about 27 ft below the surface, but judging from the rate of water level recovery after bailing, the well could not have furnished over 20 gph had it been pumped with a drawdown of 15 to 20 ft. The general contour and geological formation is such that there is very little possibility of there being any lateral movement of the underground water. Reports on other well drilling operation in the immediate locality confirm this.

The observed performance of this well, which is sunk in very poor water bearing ground, is such that outstandingly good operation may be expected where water is plentiful, especially if there is a lateral flow of the underground water.

Sonic Precipitation Shows Promise

Sound waves involve successive compression and rarefaction of the air. Because extremely small particles suspended in air tend to follow this movement, while larger particles remain relatively still, sound waves cause collision of the small particles with the large ones. Although the amplitude of these vibrations is extremely small—generally less than a thousandth of an inch—it is sufficient to give particles a push equivalent to 12 million times their own weight. Under proper conditions the dust particles will adhere to form aggregates containing as many as several hundred primary particles, which may then be collected in a standard separator. In general, the finer the particles of a suspension, the more readily are they coagulated by the sonic method, hence greatest use will be in fields where the dust particles are smaller than 10 microns, or about as fine as face powder. The agglomerates of carbon black particles issuing from the combustion chamber are in this range and the sonic apparatus reportedly collects them as efficiently as a dry electrostatic precipitator, with a cheaper installation. Other fields where the method appears promising are in the precipitation of acid mists and tar fogs, which are difficult to handle by other methods.

Natural fog is another problem that may yield to sonic precipitation, although work is still in the experimental stage. Preliminary tests for the Navy indicate that power consumption may be great, but is only one-tenth the amount consumed as fuel by the FIDO installation, which burns the fog away with flame.—*from the Industrial Bulletin of Arthur D. Little, Inc.*

How to Control
ZONED UNIT HEATER SYSTEM

SUGGESTIONS ON HOW best to solve the following unit heater control problem were asked for by "J.H." in his question published in the October HPAC:

"A building is divided into three distinct heating zones, with different temperature requirements and different rates of heat loss. Each zone is to be heated by a unit heater of suitable size and supplied by steam from a low pressure oil burning steam boiler. Temperatures in each zone are to be separately controlled, no unit heater motor shall run unless there be steam in the heater, the burner shall shut down when all zones are satisfied and shall start when any zone requires heat, and the number, type and cost of control equipment shall be kept at a minimum."

A number of answers to these questions have been received from HPAC's readers.

TWO SCHEMES USED WITH SUCCESS

IN RESPONSE TO "J.H.'s" October inquiry for a means of independent unit heater control with tie-in for the oil burner, I submit two arrangements that I have successfully used during the past several years.

The system shown in the first sketch is the less expensive method and will be satisfactory with small unit heater fan motors, 1/20 hp, a-c.

The thermostat has two independent single pole, single throw switches; one switch is connected to the heater it controls, the other switch is connected in parallel with all similar switches of the remaining thermostats and the thermostat terminals of the oil burner relay.

The "hot" line is first connected to a reverse acting pressure control. Upon a call for heat in any zone, the thermostat will start the oil burner and make contact for the unit heater. The heater remains off until sufficient steam is in the mains to close the pressure control circuit. The location of the pressure control should be carefully selected. However, if the piping has been properly designed, the system should fill uniformly.

Some installations have desired to use the fans for summer circulation. This has been done by installing switches to bypass the thermostats and pressure control (indicated by dashed lines in diagram).

The second sketch indicates a more elaborate method but one to be preferred and necessary with larger fan motors. The relay contacts are good for 1 hp, a-c.

I have one installation where four temperatures (50, 60, 70, and 75 F) are maintained; the room for 75 F is large and requires two heaters; the 70 F room is also equipped for night setback. Fifty and sixty degrees were the minimum temperatures that were to be maintained to prevent damage to the materials in those rooms; higher temperatures did not matter.

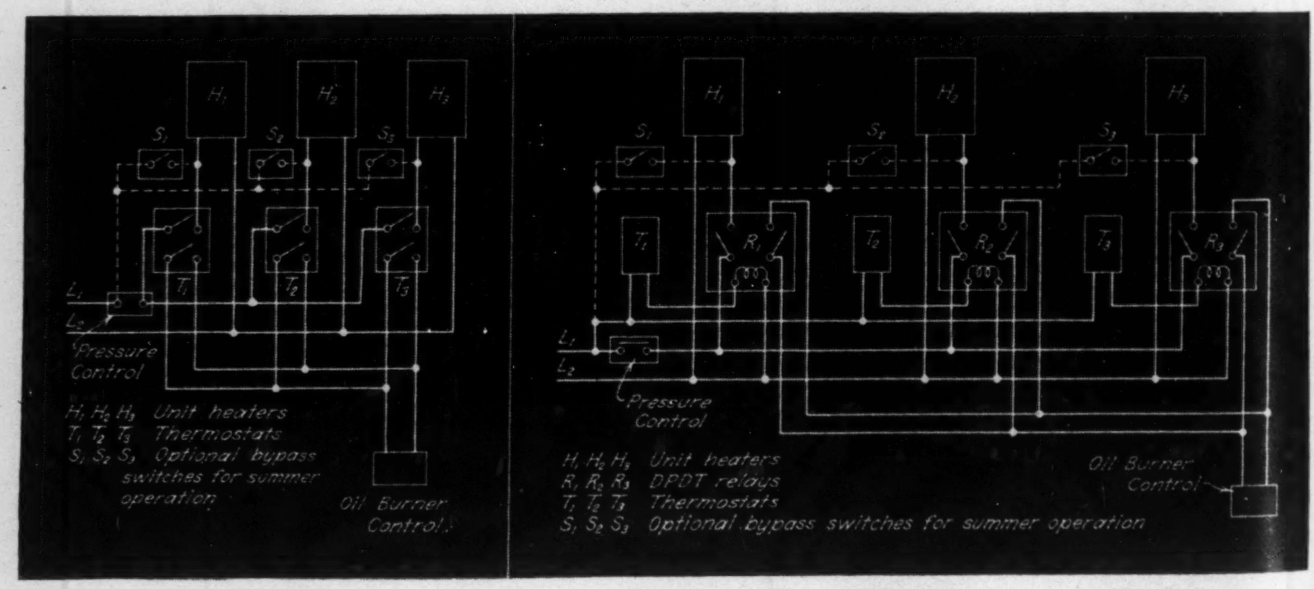
Of course, any required switch or fusetron should be provided in the hot leg at the unit heater to meet local code requirements.—A. M. L.

CONTROL EACH UNIT FROM A THERMOSTAT

MAY WE OFFER a solution to "J.H.'s" question about three zone unit heater control as stated in the October issue?

Control each zone unit heater motor from a properly located room thermostat in that zone. These can control motors directly if 1 hp or smaller and are single phase. If not

"A.M.L." has successfully used these two arrangements for several years. The first one is a less expensive scheme satisfactory for small unit heater motors. The second is more elaborate, but one to be preferred and necessary with larger fan motors


H_1
H_2
H_3
S_1
S_2
S_3
T_1
T_2
T_3
L_1
L_2
Pressure Control
H_1 H_2 H_3 Unit heaters
T_1 T_2 T_3 Thermostats
S_1 S_2 S_3 Optional bypass switches for summer operation
Oil Burner Control
H_1
H_2
H_3
S_1
S_2
S_3
T_1
T_2
T_3
R_1
R_2
R_3
L_1
L_2
Pressure Control
H_1 H_2 H_3 Unit heaters
R_1 R_2 R_3 DPDT relays
T_1 T_2 T_3 Thermostats
S_1 S_2 S_3 Optional bypass switches for summer operation
Oil Burner Control

it will be necessary to control through magnetic motor starters.

Install a strap on reverse acting temperature control on the return connection of the unit and adjacent to the unit. This will break at low and prevent the motor from starting without steam. Control is to be wired in series with the thermostat.

Wire all thermostats in parallel with a single pole, single throw relay. The relay should be connected to the oil burner starter to start the burner when any one or all units start. As the burner starter is probably low voltage, the relay may be located near the units and low voltage wiring carried to the burner to keep the wiring cost down.—R. D. A.

NEED ONLY THREE PRESSURETROLS, STATS

A SUGGESTED METHOD of handling "J.H.'s" unit heater control problem, appearing in HPAC for October, is shown in the accompanying sketch.

The only controls, in addition to the boiler controls, required to perform properly the desired operation are three pressuretrols that make contact on rise of pressure and three double pole, single throw thermostats. The thermostats can be any line voltage two stage or two circuit thermostats adjusted so both contacts make or break simultaneously.

The cycle of operation would be: If zone 2 in sketch should call for heat, both contacts in thermost t make. The burner would start and current would be up to pressuretrol 2 at which point the circuit would be open as there is no steam pressure at the unit heater. When steam pressure is available at zone 2, the contacts in pressuretrol 2 close and the motor will start.

Zone 3 now calls for heat, there is pressure on the system, therefore the contacts in pressuretrol 3 are made so zone 3 motor will start as soon as thermostat contacts are made. The same will be true in the case of zone 1. When zone 2 is satisfied, the thermostat contacts will break, which will stop the unit heater motor. The burner will continue to operate as the contact is still made through thermostats 1 and 3.

Any zone thermostat will start the burner or keep it in operation and still control only the unit heater for its zone. Each zone pressuretrol will allow each unit heater to operate only when there is steam pressure at the heater.—J. R. S.

PROPER CONTROL SELECTION ESSENTIAL

THIS IS IN answer to the question from "J.H." on unit heater control, as published in the October issue.

When a heating system is designed, we base our calculations on installation of enough capacity effectively to take care of the most severe conditions that will be experienced throughout the course of a winter season. This ultimate extreme condition will normally be expected about 5 percent of the season; therefore to operate efficiently, conserve fuel, and maintain comfort with a system that is greatly oversized 95 percent of the time, the proper selection of automatic temperature control equipment is very essential.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

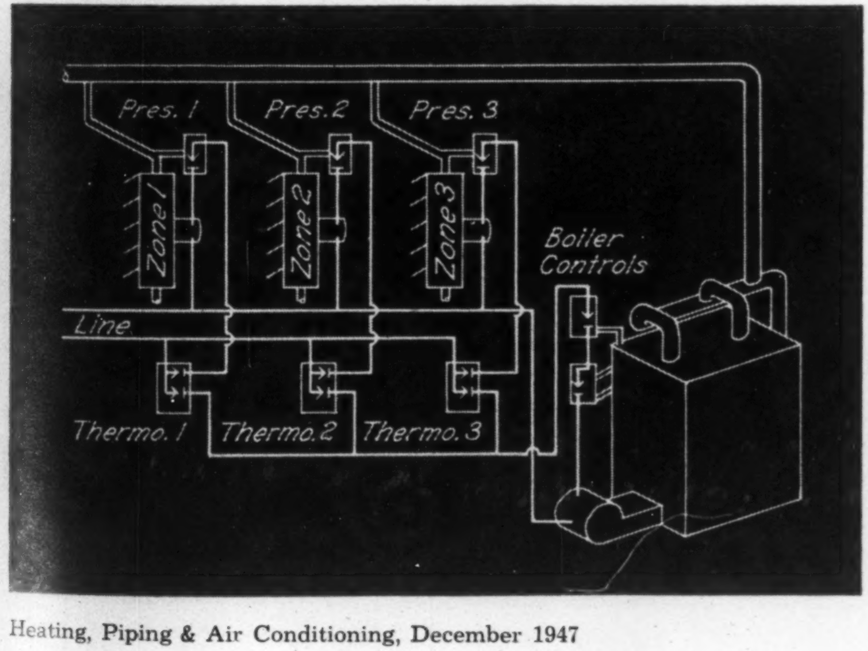
To control effectively the internal temperatures of a building, made up of two or more distinct zones or spaces, it is necessary to select one of these zones as being representative of the others and locate the thermostat there—trusting to luck that the extremes in the other zones don't become too objectionable.

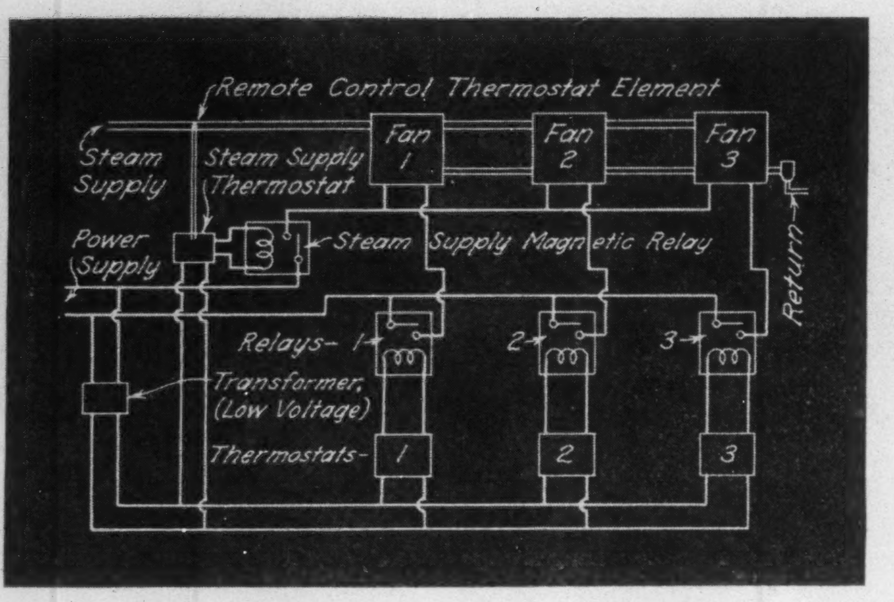
Of course, modern practice has been to get away from the use of one thermostat in a zoned building and to use a thermostat for each unit heater or zone.

However, "J.H." in his question seems to have this scheme in mind, except that I believe what he really is after is a way to control the firing of his boiler to suit his internal requirements.

I feel that the same reasoning that rules out the use of a single thermostat for the operation of the unit heaters in all zones, at the same time, can be applied in the use of one thermostat, located in a "representative" zone to operate the firing of a boiler. Of course it is impractical and complicated to use a thermostat in each zone to operate the burner when heat is required. Instead, I feel the use of an outdoor type thermostat, set to operate the burner whenever the outside temperature falls below a predetermined setting and operated in conjunction with a pressure control located on the boiler and set to over-rule the thermostat when

The only controls—in addition to the boiler controls—required are three pressuretrols and three thermostats as shown here, says "J.R.S."





Here is "W.L.'s" solution to the unit heater control problem

boiler pressure reaches 5 psi gage, would make for a simple and inexpensive control set-up.

In this arrangement, when the outdoor temperature falls below the outside thermostat setting, the boiler would generate steam. Should there be a demand in any zone for heat, the zone thermostat would start the unit heaters. These heaters would of course take enough steam so that the burner would continue to fire to generate enough steam for the demand. However, should the outdoor thermostat call for firing and none of the unit heaters require steam, the boiler would quickly rise to the pressure setting of the pressure control, which would then over-ride the outdoor thermostat and shut off the burner.

This system could easily be adapted for night and week-end service by the use of a clock thermostat with a week-end skip. The night setting should be 35 F, which would mean that whenever this outdoor temperature was reached the boiler would generate steam which in turn would activate the aquastats on each unit heater and start them. The use of outdoor control to prevent damage by freezing is more effective, as it prevents the freezing of water lines located at outside walls (which sometimes happens through the faulty location of an indoor thermostat used for the operation of a boiler).

Of course, each unit heater should be provided with either a clamp or immersion type aquastat to prevent it from operating without steam.—N. F.

BAD PRACTICE TO SHUT OFF BOILER

There is one aspect of "J.H.'s" October question about unit heater control that I must take issue with before starting a consideration of this system. That is the idea of shutting off the burner of the boiler when the zone thermostats are satisfied.

This is bad practise for at least two reasons:

1) It is more practical, and just as economical, to keep up steam after the boiler has been brought to the steaming point.

2) There are times during operation when a demand would indicate itself on the zone thermostats after a long period of shutdown. As the boiler will have cooled, there will be no steam to gratify this demand.

From the above presented reasons I will assume that this portion of the plan is not feasible.

I would suggest the installation of a pressuretrol, or some comparable device, on the boiler. This would take care of the danger of too much steam pressure in the boiler in the event of a light load period. This would have no connection with controls for the rest of the system.

The following is my solution for the rest of the system. I would have three ordinary direct acting thermostats located in their respective fan zones. These would control relays that would close one side of the fan circuit upon demand by the thermostat governing that area. There would be one remote acting thermostat with the element located in the steam supply line. When steam was present in the line, this thermostat would operate a relay which would close the other side of the fan circuit.

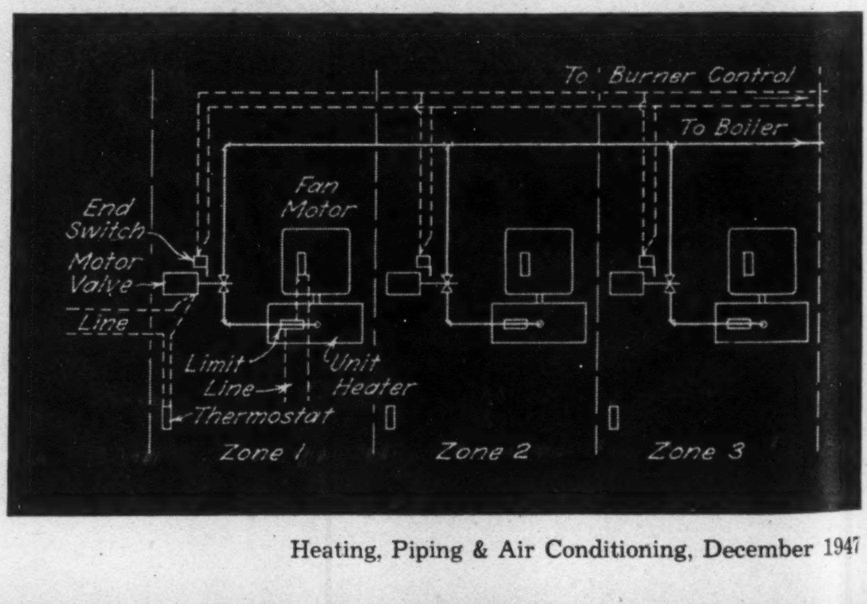
The accompanying drawing gives a complete layout of this plan.—W. L.

THIS METHOD IS "SIMPLE, DEPENDABLE"

Here is a solution of "J.H.'s" three zone unit heater control problem as published in October that is simple, inexpensive, dependable, and positive of control for each individual zone.

Only three pieces of control equipment will be needed for each zone. First, a room thermostat that will

"S.C.M." says that this method is "simple, inexpensive, dependable and positive of control for each individual zone."



actuate (second) a zone steam supply motor valve equipped with an end switch, and (third) a reverse action limit switch that will make the circuit to the heater motor on temperature rise in the coil.

From an all off position, the operating cycle is as follows: Any zone thermostat calling for heat will open the motor valve to that respective supply. As the valve reaches full open position the end switch will close the oil burner control circuit thus starting the burner. When steam reaches the heater the limit switch on the heater will start the fan motor which will continue to run so long as steam is available or until the thermostat closes the motor valve. The last of the three motor valves to close would open the oil burner control circuit, thus stopping the burner.

Wiring the Controls and Valves

Each of the heater limit controls would be wired independently. Also, each thermostat with corresponding motor valve would be independently wired. The three end switches on the motor valves would be paralleled on a pair of wires which in turn would be connected in series with the usual complement of burner controls supplied with the oil burner.

The chief disadvantage of the time lag while the boiler heated up after a long off period could be overcome through the use of a combination high and low limit switch on the firing apparatus, which would allow the boiler to "coast" during off periods of all zones. This could be considered as optional if desirable to provide immediate recovery from long off periods. Any over-run of temperature after the closing of a motor valve would no doubt be of minor consequence unless the heaters were equipped with very heavy cores.—S. C. M.

TWO SCHEMES BASED ON SAME PRINCIPLE

In reply to the question from "J.H." in the October issue of the magazine on the question of controlling three unit heaters and an oil burner, I have prepared two diagrams which I believe use the minimum number of controls for the conditions set up.

The principle of operation is the same in both in that primary control is by T1, T2, T3 or T7, T8, T9 room thermostats which close the circuit on a drop in temperature. Each stat is of course located in its individual zone. T4, T5, and T6 are the equivalent of low limit stats located at each unit heater with the bulb attached to the steam return leg immediately at the outlet. These controls insure no operation of the fan unless there is steam in the coils.

The second bulb in T1, T2, and T3, of one sketch serves the same purpose as the relays R1 R2, and R3 in the other sketch. This is the oil burner interlock which will keep the burner from running if the temperature is satisfied in all three zones. When in operation the burner is normally controlled by a conventional pressuretrol set for low pressure limits.—C. R. K., Jr.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

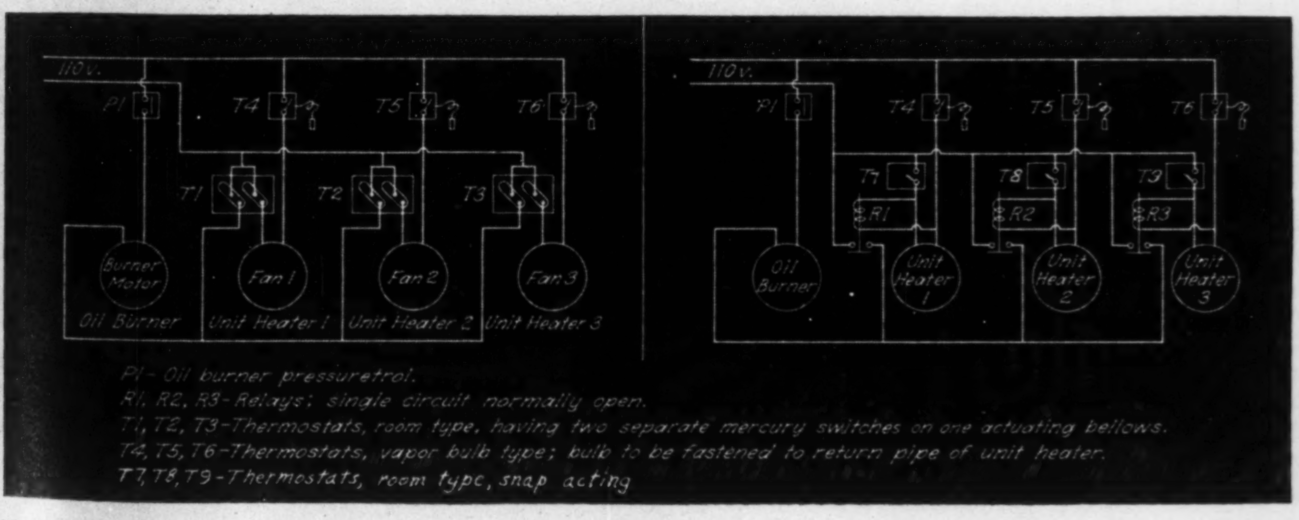
WHEN USE WHICH TYPE STEAM TRAP?

You are invited to comment on the following question from "F.S." Suitable discussions of this matter will be published, and paid for at regular rates (with additional payment for sketches). Address The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"This is perhaps too general a subject for publication in HPAC's Question of the Month department. However, it is a matter of importance to me, and I think it is one that concerns many, many readers of the magazine. I am sure that comments on it would be of considerable interest.

"Briefly stated, here it is: Which types of steam traps should be used for which applications? There are, of course, several kinds of traps available, each having applications to which it is particularly adaptable. What types of traps should be used for the different heating, piping, and air conditioning services?"

"C.R.K.Jr." believes these layouts use the minimum number of controls for the conditions as outlined. Principle of operation is the same in each of these two sketches



P1 - Oil burner pressuretrol.
R1, R2, R3 - Relays: single circuit normally open.
T1, T2, T3 - Thermostats, room type, having two separate mercury switches on one actuating bellows.
T4, T5, T6 - Thermostats, vapor bulb type; bulb to be fastened to return pipe of unit heater.
T7, T8, T9 - Thermostats, room type, snap acting

SAM LEWIS' PAGE

Informal comment on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer and member of HPAC's board of consulting and contributing editors. This month he considers the case of a small building with stores on the ground floor and individual offices on the upper floors. All the rooms received air at the same temperature from the central heating and cooling installation, with no means provided to meet their varying needs. The problem was solved by installing small two-row reheating convectors in the air stream from each existing supply register throughout the building.

Reheaters for Each Supply Register Improve Heating and Cooling System

OBJECTIONS ARE sometimes made to the alleged wastefulness of reheating air that has been expensively subjected to refrigeration. But there are cases like those in the building we are considering this month in which reheating of refrigerated air proves eminently justifiable. Despite the reheating in this case, the economies due to proper control were so great that no increase in the amount of refrigeration for air conditioning the structure was required.

It is an ell-shaped three story office building above stores on the ground story. There are about 20 small rooms on each floor, these being rented to diversified tenants.

The building is about 15 years old. The original designer provided an all-indirect heating system, with a supply fan in the basement drawing outside air which was heated to the necessary extent (about 130 deg at −10 F outside), and was delivered at one temperature for all spaces through a trunk line riser to horizontal metal ducts along the corridor ceilings. From these ducts each office room received its quota of air through a register in the corridor wall near the ceiling.

Most of the offices have transverse partitions midway between the corridor and the outside wall and all the warm air that reached the outer rooms was compelled to flow through doors and transoms in the transverse partition. There are no radiators in the outer offices.

There are, of course, in such a building at least four corner rooms on each story that have increased heat transfer beyond that of the intermediate rooms. These corner rooms usually will be cool in winter when the other rooms are warm. Each tenant had a chance to balance the temperature manually by varying the volume of air delivered to his particular space, but he never did succeed noticeably. The corridors were employed for recirculation and waste of air, there being a small register at floor level from each room into the corridor.

This sort of heating system was difficult enough to manage, and the situation was complicated still further by using cold well water for cooling and dehumidifying the air in summer. Control of temperature in the various rooms with the different exposure areas and varying solar heat reception was even more difficult in summer than in winter.

The relatively cool air delivered overhead into the inner offices tended to fall quickly to the floor and passed out to the corridors, without flowing through the outer offices, so that the primary sense impression for a visitor was that the corridors, at least, were delightfully cool in summer.

Eventually, however, the ground water temperature increased to such an extent that it became necessary to abandon the well, and a direct expansion refrigerating plant was installed. Operation of the compressor motor responded to suction pressure of the evaporator, and no means was provided for increasing the temperature of the nearly saturated air leaving the evaporator.

Tenants a "Long-Suffering Lot"

The tenants were a long-suffering lot, subjected to a year around general average temperature common to the whole building and not conforming at all to the constantly changing sun and wind and occupancy conditions for any given room. It finally became necessary to do something about correcting these troubles.

It appeared at first that a direct radiator could be installed in each outer office to correct the winter condition. Then the air delivery temperature to all rooms could be close to 70 deg, and the varying demands for heat could be met by adjusting the radiator valves. However, there was no basement in which steam and return mains could be placed acceptably, and the ground story was occupied by tenants who could not endure interference with their elaborate fixtures and merchandise by any pipes or ducts. Also, installation of the radiators would not help correct the summer temperature control troubles. The horizontal sheet metal air supply ducts were furred in above the corridor ceilings and any changes in these ducts would involve serious interference with tenants, would raise objectionable dust, and would of course require redecorating.

The installation of individual automatic temperature control the year around for every room was imperative.

Reheating Convectors Installed for Each Space

The final solution was to install in the machinery room a converter for heating water, and a pump for circulating this water. In the lower office story, paralleling the corridor on each side, water flow and return mains were placed overhead, exposed in the inner offices. These serve small two-row reheating convectors located in the air stream from each existing supply register throughout the building.

A thermostat in each room controls the water flow valve to the respective convector. In winter, the general air supply delivery temperature is kept at about 70 deg by a duct-located thermostat and by valves on the steam supply connections to the convectors at the fan. The new local reheaters, with water available at temperatures up to 250 deg, satisfactorily controls the delivery of heat to each office.

In summer, a duct thermostat controls face and bypass dampers at the evaporator-convectors to maintain approximately 60 deg and 60 percent relative humidity and the new individual reheating convectors in the rooms warm this heavy, damp air as required to maintain reasonable comfort in each room.

The investment cost of these additions was about $30,000 compared with an estimated cost of over $50,000 for any other scheme likely to achieve commensurate results.

FHA Issues Data on Aluminum Ducts

An important application for aluminum that has been developed extensively during the past year is in air ducts for heating, ventilating, and air conditioning systems of all types.

In a supplement to its "Use of Materials Bulletin UM-1," the Federal Housing Administration gives alloy specifications, minimum thicknesses for both enclosed and nonenclosed ducts, and reference to construction and installation requirements. Use of aluminum hangers and fastenings is also recommended:

ALUMINUM BUILDING PRODUCTS

Section 8. Aluminum Ducts

a. *Construction and Installation.* All requirements relating to ductwork and now in force in local insuring offices shall be applicable to aluminum ductwork unless otherwise indicated herein.

b. *Aluminum sheets* used for ducts shall be of corrosion-resistant alloy such as 2S or 3S having a minimum ultimate tensile strength of 15,000 psi and capable of being bent flat on itself without cracking.

c. *Minimum thickness* of aluminum sheets shall be as follows:

(1) *Ducts not enclosed*

Round Ducts

Diameter, Inches	Minimum Thickness of Aluminum	
	Brown & Sharpe Gage	Inches
Less than 12	26	0.016
12 or more	24	0.020

Rectangular Ducts

Larger Dimension, Inches	Minimum Thickness of Aluminum	
	Brown & Sharpe Gage	Inches
Less than 14	24	0.020
14 or more	22	0.025

(2) *Ducts enclosed*

Diameter or Larger Dimension, Inches	Minimum Thickness of Aluminum	
	Brown & Sharpe Gage	Inches
14 or less	26	0.016
Over 14	24	0.020

d. *Special protective coatings* acceptable to the Chief Underwriter may be required if, in his opinion, the aluminum ductwork will be subject to corrosive action under damp or wet conditions by alkalis in masonry or plaster.

e. *Non-alkaline insulation* acceptable to the Chief Underwriter may be required if, in his opinion, insulated aluminum ductwork will be subject to corrosive action under damp or wet conditions due to alkalis in the insulating material.

f. *If adhesives are used* in securing insulation to aluminum ductwork, they shall be of a type recommended by the manufacturer of the aluminum sheets and acceptable to the Chief Underwriter. Casein type glue is not acceptable.

g. *Hangers and fastenings* shall be of aluminum (preferred) or of steel with cadmium or zinc coating.

HAROLD O. HILL HEADS WELDING SOCIETY

The American Welding Society has elected as its president for the year 1947-48 Harold O. Hill, assistant chief engineer, fabricated steel construction, Bethlehem Steel Co.

Employ Engineering to Correct the Individual Smoke Problem

REFERRING TO THE material titled Does the St. Louis Smoke Law Work?, published on pages 80 and 81 of the November HPAC, and comprising a news release from our committee and Raymond R. Tucker's comments thereon, I want to say that if others took this same position, and brought this matter out into the open as HPAC has done, a great deal would be accomplished in setting this country on the true path of smoke abatement.

If our release concerning the St. Louis smoke abatement experiment has done nothing else, it has at least brought a sound admission from Professor Tucker, for he says: "The subject of air pollution is very broad and complex."

I have never discredited St. Louis' attempt to eliminate its air pollution. It has been a worthy effort. What I do say is that whatever gains that were made there came through the awakening of the public consciousness against smoke and by applying engineering principles to solve individual smoke problems. St. Louis made the mistake of claiming too much—a miracle.

H. B. LAMMERS states here that he believes whatever gains have been made in St. Louis to eliminate air pollution "came through the awakening of the public consciousness against smoke and by applying engineering principles to solve individual smoke problems." He feels—very strongly— that the air pollution problem of a city cannot be eliminated automatically by passage of an ordinance of the St. Louis type, which prohibits the burning of high volatile coal with hand fired equipment

This is an age of "pushbutton" thinking. If we are to have a "button" for this, and a "button" for that, we engineers had better begin to look around for another profession.

So far as I have been able to determine, no one in St. Louis has ever been cited for violating the smoke ordinance while burning low volatile or "legal" coal. And yet within the last few weeks I surveyed the smoke problem of the city of Philadelphia in company with the Philadelphia smoke inspector. Among others, we inspected fuel burning plants against which there were as many as 800 complaints. Many of these plants had modern equipment; and they were burning not high volatile coal, nor Mr. Tucker's "magic" 23 percent volatile coal, but in some cases 15 percent volatile coal and low volatile coal from central Pennsylvania. I should be glad to return to Philadelphia in company with Professor Tucker any time at his convenience and show him many such smokers.

I have copies of certain St. Louis newspaper items which I think should be mentioned in the interest of accuracy and in answer to some of Professor Tucker's statements. One reports that five commercial air flights were compelled to bypass the city on August 16, 1947, because smoke so obscured visibility that the planes were unable to land. Another quotes the deputy smoke commissioner as saying that atmospheric conditions in St. Louis are "rotten." Another is a picture of a smoke pall taken on September 10, 1947—long before the heating season was under way.

And last but not least are the smoke hours recorded by the Weather Bureau in St. Louis. In January of 1939—14 months before the "low volatile" ordinance was passed—16 hr and 45 min. of objectionable smoke palls were recorded. In January of 1944—almost four years *after* the ordinance was passed — the Weather Bureau recorded 46 hr of objectionable smoke palls. What becomes of Professor Tucker's claim of a "miracle" when these figures are examined?

Or take October of 1939 (long before the ordinance was passed) with a record of 9 hr and 30 min. of smoke palls, and compare it with October of 1944 which shows 34 hr and 30 min of smoke palls.

It is quite true that in December of 1939 and in January, February, and March of 1940, there were unusual amounts of smoke. But this was due to unfavorable atmospheric conditions and unusual low temperatures. *Yet it is upon the figures for these months alone* that the claim is made that St. Louis reduced its smoke by "72 percent"—a "miracle." Such a claim, based upon such narrow grounds, cannot be very convincing to most people.

If St. Louis "eliminated" its smoke by the passage of the low volatile ordinance why is it still necessary to maintain a smoke department with 26 to 30 persons? If Cincinnati is to achieve wonders by copying the St. Louis plan why does the Cincinnati Post, which went all out for the St. Louis type ordinance which was passed March 5, 1947, now admit that there was 12 percent more sootfall in September 1947 than in the corresponding month of 1946. September was the first heating month under the new ordinance.

Professor Tucker quotes a statement to the effect that there are 177,000,000 tons of low volatile coal available yearly and that of this amount 50 percent or 88,000,000 tons would be suitable for domestic use. These figures have been discredited so often and have been changed so frequently that I am amazed that Professor Tucker still uses them.

First of all, it was testified in open hearings that only 27 percent of the production of the Pocahontas field is suitable for domestic firing. Then in a complete tabulation of the production of the Pocahontas field since it was opened in 1883, it was shown that the highest production ever achieved by that field was in 1942 when 33,883,554 tons were produced. Despite the cry for coal and more coal the production of the field has steadily declined until 1946 when the production is shown as 26,433,320—a drop of almost 7½ million tons. Of the 26 million tons production approximately 6 million represents captive tonnage. So we have a net of 20 million tons of which 27 percent, or 5,400,000 tons, is domestic sizes.

But statistics are not always convincing. The main fact is that St. Louis is experiencing extreme difficulty at the moment in obtaining sufficient low volatile coal. Cincinnati and Pittsburgh are in the same situation. It is expected that these two cities will declare an emergency before the heating season really gets under way.—H. B. LAMMERS, director of engineering, Coal Producers Committee for Smoke Abatement, Cincinnati.

"OPEN FOR DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Plastic Tubing Used for Gas Service

ONE-INCH extruded plastic (cellulose acetate butyrate) tubing is being used as gas pipe by the Southern California Gas Co. The first installation was made in 1945, after nearly three years of testing, and permanent use of it to conduct fuel gas from the main to the customer's meter is "now thought to be practically assured."

The gas company's tests revealed that such tubing could be used almost everywhere, except where it might come in contact with refinery gases and other products of oil refining. The tubing is laid only in mild soils, not in rocky ground (since rocks could pinch the tubing together when the excavation was filled and tamped), and is placed at the standard depth of 18 in.

Joining is simple. The two ends of the 1 in. *outside* diameter plastic pipe are coated with a solvent cement and joined. A sleeve of 1 in. *inside* diameter tubing, similarly coated on the inside, is then slipped over the joint, and the three pieces are "welded" together at once. Cement is colored to provide for easy visual inspection of the joint.

Joints are covered with grease, two wraps of cellulose acetate sheet, and one of kraft paper. This makes a suitable shield for mild soils.

Gradual bends in the flexible tubing are easily accomplished on the job. Right angle bends are made, in accordance with company rules, by means of prefabricated right angle sections sleeve jointed to the tubing.

Joints at the service T, where the plastic pipe meets the steel gas main, and the riser, where a copper tube joins the plastic pipe, are made with fittings which are preassembled iron joints in the shape of hollow dumbbells. A gastight assembly is made by tightening the ends of the fitting, which contains rubber glands in either end, around the plastic pipe, metal T, or riser.

The plastic pipes and joints are made to stand up under a maximum safety pressure of 30 psi, although in tests they are said to have withstood far higher pressures.

Joining lengths of plastic gas pipe used in Southern California Gas Co. installations requires little special equipment. Only a solvent cement and a sleeve of larger diameter tubing are needed. The two ends of pipe to be joined are coated outside with cement; the sleeve is coated on the inside. When the sleeve is slipped over both ends, the joint "welds" together immediately. Cement is colored to provide easy visual inspection of joints. Protection for the joint is provided by a covering of grease, two wraps of cellulose acetate sheet, and one of kraft paper. This is a suitable shield against mild soils

Simplified Figuring of Cooling Coils Too Often Unsatisfactory

AT PRESENT, the methods of calculation for air cooling coils using water as recommended by most sources of information fall short of attaining satisfactory engineering standards. Accuracy has been sacrificed for simplification. In fact, they seem to be directed toward the "trial and error" type of designing, rather than to serving the needs of engineers who like to maintain a high level of practice. This tendency certainly does not do justice to the engineering profession as a whole. It must not be inferred, however, that the writer's purpose here is to suggest methods of calculation so involved and intricate as to require an unconscionable amount of time to work out.

There is the story about a certain manufacturer's representative, addressing a meeting of sales engineers. This gentleman presented quite an elaborate method of figuring the capacity of a certain piece of equipment. It took considerable time, and at the end he asked for comments. A man got up and sounded off as follows: "All I can say is this—if I used your way of estimating, my competitor would have the equipment sold and installed before I even had my price figured out." . . . But there is always a happy medium and there is no reason why it cannot be achieved.

IN THIS "letter to the editor," a designing engineer points out that simplified "rule of thumb" methods for water-using air cooling coils are too often unsatisfactory, and mentions an industrial air conditioning job involving $100,000 worth of coils where results using such rules gave answers ranging from seven to 11 row coils

Calculation methods for direct expansion coils using volatile refrigerants are generally well handled. Tables giving reasonably close figures on the condition of the outlet air under various operating conditions are available. But water coil calculations have always been a "hodge podge." The writer appreciates that with all the variables encountered in water coil operation, it may not be practicable to set up complete and accurate tables—but better procedures than those now offered should be available.

A number of able and competent papers on the performance of water cooling coils have been presented during the past few years, but for some reason the techniques introduced in these papers have not been generally accepted by the industry, which seems to prefer to stick to the "rules of thumb." And these rules sometimes lead to wide variations in calculating the amount of coil surface required for a specific operation. In fact, it is possible by using the various methods to come up with a different answer for almost each one used. Some of these differences are by no means small.

It will be recognized, of course, that there are variations in coils of different makes—such as the ratio of secondary to prime surface, the size of the tubes and fins, the amount of external surface per square foot of face area, and so on. But these physical variations usually balance out pretty well in average coil work, while the variations in the computations do not balance out so satisfactorily.

For example, the writer recently has had occasion to work out some coil surface requirements for a rather large installation using well water as the cooling medium and he employed several different calculation methods. The answers he got were astonishing. The amount of surface needed to handle the load under identical conditions varied from seven to 11 rows in depth, depending on which method was used.

$100,000 Worth of Coils

The methods used, with one exception, were of the simplified "rule of thumb" type. Simplification is all right, but when it permits variations in calculation up to almost 40 percent, simplification is achieved at the expense of accuracy. In small installations, where a large allowance for safety may be taken, accuracy may not be too critical. But when about $100,000 worth of coils is at stake, the engineer should not be forced to say, "Well, I'll add on a couple of rows, just to be sure."

In this case, the writer felt he had no right to gamble with his client's money in making a choice between seven and 11 rows, so resource was made to newer, more realistic ways of calculation. These methods, based on the previously mentioned papers on this subject, offer a sharp contrast to the older trial and error calculations. In the first place, they recognize that under certain conditions, part of a coil may be dry and part wet.

Such a condition makes for an entirely different performance than when all the surface is wet. The work cannot be shown by a straight line on a psychrometric chart.

Part Dry and Part Wet Surface

The newer methods make allowance for this condition by setting up a method of calculation to show how much surface is dry and how much wet. Then the dry and the wetted surface are figured separately. For the latter surface, which is doing both sensible and latent heat removal work, total heat transmission coefficients and total heat differences are used in figuring.

In many well water installations, with the initial water temperature 50 F or higher, where it is necessary (in order to reduce water use and pumping costs) to take a considerable water temperature rise through the coil, one encounters a partly dry and partly wet coil. The use of the so called "straight line" method of plotting the work of such a coil on a psychrometric chart will result in fallacious answers. In the writer's opinion the "straight line" method is not competent. Using the newer methods and dividing the coil—for purposes of calculation—into a dry and a wet section, very uniform answers were obtained for the amount of surface required.

Coefficients Must Be Available

Some of the newer techniques place considerable stress on surface temperatures, while others do not. A few of the "rule of thumb" methods also use surface temperatures, but almost invariably one value only, either the temperature of the last row or a so-called average temperature. However, as water coil surface may vary in temperature from 10 to 20 deg between the first and last row, such figures can hardly be regarded as reliable criteria of the performance of the coil. The newer ways of calculation show how to evaluate the surface temperature of any part of the coil, the only correct way of making use of them. However, as they are a bit tedious to figure, the writer suggests that, except for finding the "boundary line" between dry and wetted surface, their use be curtailed as much as possible.

Use of internal and external film coefficients of heat transmission as outlined in the newer methods is a big step in the right direction, because these coefficients—more than anything else—help the designing engineer to visualize the work and efficiency of any coil. It must be emphasized, however, that accurate values for these coefficients must be made available by the coil manufacturers. A uniform procedure for determining these coefficients, the same procedure being followed exactly by all manufacturers, will prevent distortion of performance values caused by variations in the coefficients.

Using the newer methods instead of the old "rules of thumb," and with accurate values for the coefficients, it should not be difficult for the average engineer to calculate water coils with accuracy and with promptness.—F. S.

"OPEN FOR DISCUSSION"

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Preventive Maintenance, Spare Parts Important

Following are my comments on Donald A. Kepler's article in the November HPAC, Practical Pointers on Air Conditioning Plant Operation, in which he suggests a proposed rating scale.

Under one of the headings, it is asked if the operating personnel "has had air conditioning design and layout experience." Would a man who has had air conditioning design and layout experience be operating an air conditioning plant, or would he still be working on the drawing board, or be doing engineering and design work?

Shouldn't the operating personnel be rated on experience as well as the other items? Most people will realize that an experienced crew can operate air conditioning systems, as well as any other machinery, better than can novices.

Under the heading on operating aids, it is asked if "critical spare parts are kept in stock (5 points)." It is my opinion that this item should rate higher than 5 points. The main responsibility of the operating crew is to keep the systems in operation. Usually a system operating at perhaps 80 percent efficiency is better than one not operating. How can the crew be expected to maintain continuous operation without a stock of critical parts, because any piece of equipment is subject to wear and breakage?

Keep Complete Set of Critical Spare Parts

At Eli Lilly and Co. we keep a complete set of critical spare parts; this has saved us much production time that otherwise would have been lost. We are now working on a preventive maintenance schedule, which should enable us to detect any wear, misalignment, or distortion in any parts of the system so that we have time to order replacement parts as the inspection suggests.

We also have a daily operating schedule whereby the operator records the temperatures and humidities in the air conditioned rooms as well as the temperature of air at various stages in the equipment, cooling water, reactivation air (if a desiccating unit is being used), damper settings, operation of each piece of equipment, and general cleanliness of the conditioning equipment.—B. G. Evans, engineering dept., Eli Lilly and Co., Indianapolis.

Complete Information Needed for the Best Use of Well Water

IN THE OPENING sections of his article on Water from Wells, in the November HPAC, G. E. Clancy clearly points out a number of the reasons why groundwater supplies have often been undeveloped as a source of cooling water in spite of their obvious advantages over surface supplies. In many areas there is a general lack of knowledge of the quantities of water available from local aquifers, or water-bearing strata. In spite of the fact that great strides have been made in exploration techniques and in the techniques of actual well construction, most people believe that the development of well supplies is primarily a matter of chance. Usually there is an uncertainty as to where reliable groundwater information can be obtained. Mr. Clancy, in a latter section, suggests that it can often be supplied by local well contractors and well pump vendors and that some city and county engineers' offices may be able to supply usable data. Because of the importance of this subject a more complete discussion of "sources of information" may be appropriate.

ROBERT R. STORM gives additional information (in this discussion of G. E. Clancy's article on Water from Wells in the November HPAC) on sources of groundwater data, types of wells, and the importance of knowing the source of the water available to the well. Good water supplies are not properly developed, or are subsequently ruined by improper rehabilitation practices, if basic differences in wells are not understood. Use of groundwater for air conditioning systems, and as a heat source for the heat pump, make the subject of wells and their development of importance to heating, piping, and air conditioning engineers and contractors

Sources of Information on Groundwater

In most states, the state geological survey, state water commission, department of conservation, or some similar organization—often in cooperation with the United States Geological Survey—collects and files information on groundwater supplies. Well logs, water level records, pumpage records, temperature data, water analyses, and much other data are available to the public for the asking. Some of these organizations will without charge prepare reports on the groundwater possibilities at any location for which a request is received. Some are prepared to undertake groundwater surveys, either free or at cost, in which geophysical equipment is utilized to outline the most promising area for testing. The services of these organizations are too often either unknown to the general public or greatly misunderstood and consequently not utilized. Water well drillers' associations, where organized, and the more progressive and competent well contractors in nearly every state are cooperating with such agencies by furnishing well logs, sample cuttings, water level data, and other basic data.

All groundwater development projects should, at their inception, be guided by the information available from such state organizations. And conversely, all data obtained during a groundwater development project should be furnished to such organizations to increase the general fund of groundwater information.

Four Sources of Water

As a preface to the subject of the utilization of well waters Mr. Clancy discusses the sources of water available to wells. Some amplification and clarification of the four sources noted may be pertinent.

Groundwater may be classified as "free water" or "confined water." A "free water aquifer" is one which is not overlain by impermeable material, i.e., surface water is free to percolate downward from the ground surface, by gravity, until it reaches the zone of saturation. The top of the zone of saturation is called the "water table." Sources number 2 and 3 as outlined by Mr. Clancy are of this kind and wells developed in these zones can be designated as "water table wells."

If the water bearing material is overlain by impervious material it contains "confined water," and the permeable material is designated a "confined aquifer." Nearly all confined water is under some pressure due, for the most part, to the weight of the water in the aquifer that occurs at higher elevation. If water under such "artesian" pressure is encountered in a drill hole, it will rise in the drill hole to a height (static level) determined by the amount of pressure at that point. A well encountering water under artesian pressure is designated an "artesian well." If the pressure is sufficiently great the well will flow. All flowing wells are artesian wells—but not all artesian wells flow. By such a definition sources 1 and 4 as outlined by Mr. Clancy are confined aquifers into which artesian wells can be drilled.

It is important to differentiate between water table wells and artesian wells because of their fundamental differences in behavior under pumping conditions. Water level data must be interpreted differently for the two types of wells. A falling water level in a water table well and a decline in the static level of an artesian well are in no way related—they result from entirely different causes and are symptoms of entirely different troubles—yet, unless they are properly understood, they are treated in the same manner. A decline in the water level of a "water table well" registers a lowering of the water table itself, which means that the upper portions of the "free water aquifer" are actually being dewatered and the total volume of available water is being reduced. On the other hand, a decline in the static level of an "artesian well" registers a lowering of the pressure on the water in the aquifer and the total volume of water in the aquifer remains essentially the same. Lowered static levels mean increased pumping costs but do not mean that the supply is diminishing.

Improper Practices Can Ruin Water Supply

It is unfortunately true that most people, including many engineers and contractors, do not realize the basic differences with the result that good supplies are not properly developed or are subsequently ruined by improper rehabilitation practices. Artificial recharge practices must also be conditioned by the type of aquifer being exploited. It is therefore clear that for the proper development and use of a groundwater supply the exact nature of the source should be fully understood and the advice of a competent hydrologist or groundwater geologist should be sought previous to the development of such a supply.

Temperature of Groundwater

In his discussion of groundwater temperatures, Mr. Clancy does not make clear the basic reasons for temperature differences in groundwater aquifers. Except for special cases, groundwater temperature varies directly with depth. The geothermal gradient throughout most of the United States is usually about 1 deg rise in temperature for every 100 ft increase in depth. (The latter may vary from 60 to 120 ft locally—any special conditions may cause even greater variations.) Except in some cases of very permeable gravels at shallow depths where exceedingly large natural or artificial discharges cause a rapid movement of groundwater, the rate of movement of groundwater is usually sufficiently slow to allow the water to reach the temperature normal to the depth of the aquifer. In general, water table wells are shallow and the water temperature seldom exceeds the mean annual surface temperature by more than a few degrees, if at all. Water temperatures in artesian aquifers usually are determined by the geothermal gradient for the area.

In his discussion of the methods of drilling and developing wells, Mr. Clancy rather naturally emphasizes the procedures common to California. He discusses the procedures used in perforating casings but neglects to mention the use of well screens. In most parts of the country, screens have proven to be far superior to perforated casings in developing wells in unconsolidated material. Well screens are scientifically constructed to allow the inflow of a maximum amount of water while at the same time preventing the ingress of sand particles into the well. Screens can be "tailor-made" for each well. Their correct use insures the development of the maximum capacity of a well.

Days of the "Hole Puncher" Are Ending

Mr. Clancy has pointed out that advice of the local well contractor should be considered in planning the design and construction of a well. He should perhaps have added that the well will be only as good as the contractor's ability to construct it and that a careful and thorough investigation of the abilities of the available contractors will pay dividends. The competent contractors today are highly trained men, skilled in the use of specialized equipment. The days of the "hole puncher" are coming to a close.

Mr. Clancy is to be congratulated on his very practical approach to this general subject. The use of groundwater supplies for cooling and heating installations is increasing steadily because the mysteries of groundwater occurrence and development are being reduced steadily as scientific data are being collected, organized, and evaluated. —Robert R. Storm, associate geologist, division of groundwater geology and geophysical exploration, Illinois Geological Survey; executive secretary, Illinois Water Well Drillers Association, and editor of the association's Water Well Journal.

"OPEN FOR DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

HIGH TEMPERATURE WATER JOBS NEED CAREFUL STUDY

Frank H. Slade's article, High Pressure Hot Water Serves Hospital Project, published in the October HPAC, is indeed interesting from the standpoint of practices in other countries.

Although a large amount of heat can be distributed by high temperature hot water, rough calculations indicate that to transport and return this water any great distance requires a substantial amount of mechanical effort unless pipe sizes are rather large. Also, care would have to be exercised to make certain that the pressures throughout the circuit remained sufficiently high to prevent any flashing of this high temperature water into steam.

A careful economic study would be advisable before this method were employed for any particular project providing steam could also be used. Certainly higher initial pressures because of line friction are necessary for a water system as compared to a steam system for the same approximate operating temperature of these heating mediums. —William Sturm, Ellerbe and Co.

CONSTRUCTION MATERIALS SHOW GAIN

Physical production of construction materials in August, as measured by "an improved composite index" of 20 selected materials, reached 147.0, the peak level of the year and a somewhat more-than-seasonal advance of 8 percent over July, according to the October industry report on construction and construction materials, prepared by the U.S. Department of Commerce.

Suggests We Abandon "Comfort," and Air Condition for Health

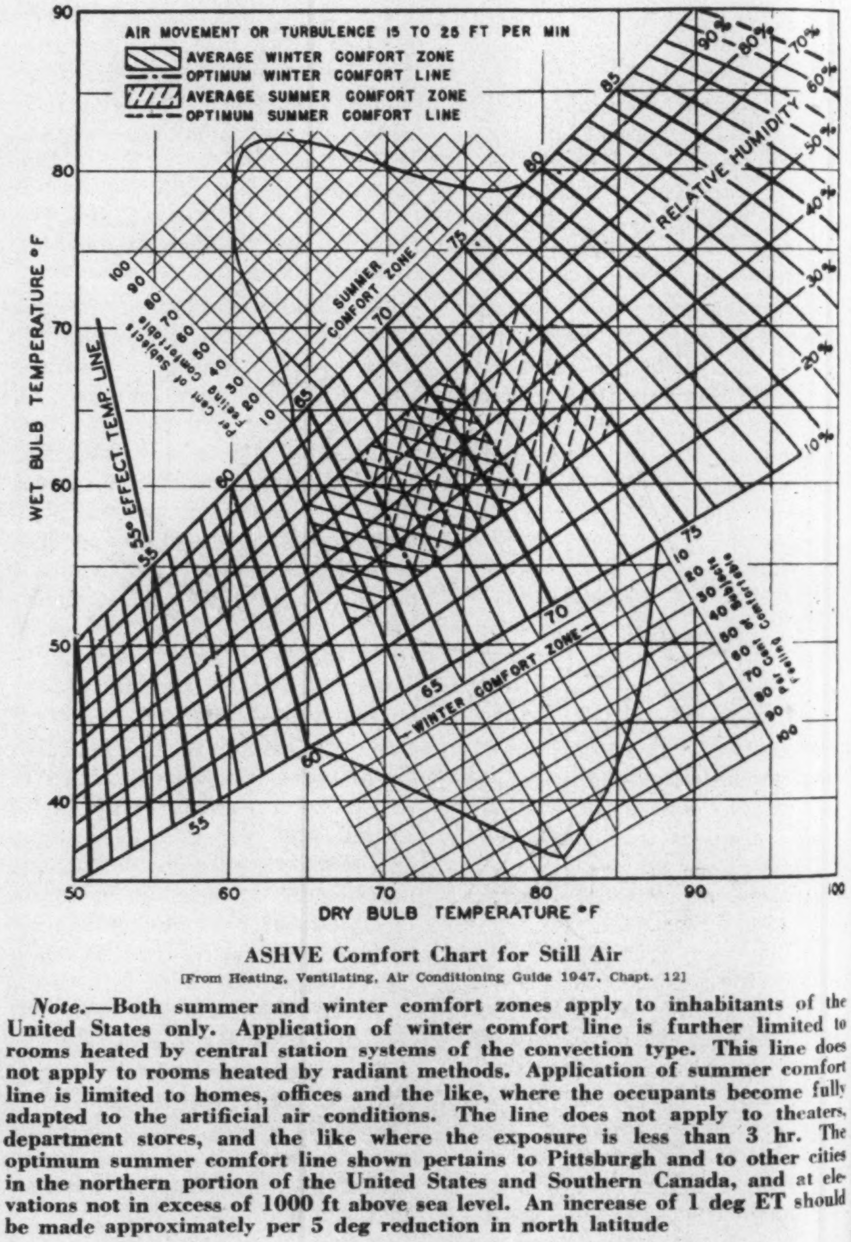
Isn't it time that we abandon the word "comfort" in air conditioning work? When you talk about equal comfort lines on the effective temperature chart as being separate and distinct from lines of equal warmth you add chaos to confusion. As a matter of fact, neither of them has much to do with the comfortable state of the body which is in normal good health. For 15 years we have read of, and heard discussed, effective temperatures but our literature is silent on the much more important subject of conditions of air for healthful living.

Sixty-six degree effective temperature has been reported as the optimum for winter, which corresponds to 72 F and 30 percent relative humidity. This is too cold, as any of us knows who has installed air conditioning systems for ordinary office workers. Systems that are considered healthful and therefore comfortable are being run at 75 F and 20 to 30 percent relative humidity or practically 68 deg effective. Changing the humidity may have some bearing on the subject but not nearly so much as panel cooling effect of cold walls, glass block areas, and roofs. There is no use jousting with effective temperature when we disregard entirely the panel cooling effect of cold surfaces.

High lighting loads frequently make warm ceiling panels. Air distribution through ceiling outlets frequently warms the ceiling, or even the perforated ceiling method of distribution changes the character of the space whereby the ceiling becomes a panel cooler or heater depending on the temperature of the air passing through the perforations. Changes of this kind seem to be important in setting up automatic controls.

The summer comfort line is supposed to be 71 deg effective, or 76 F and 50 percent. This is somewhat too cool and here again the successful air conditioning systems in modern offices are generally carried around 78 F and 45 to 50 percent or 72 deg effective. Small changes of humidity are not noticed and the fallacy of trying to carry variable inside temperatures with varying outside temperatures has led to many disappointments. You cannot go above the perspiration point, which is about 74 deg effective, and you never should go below 71 deg effective. The whole comfort *zone* shown in the ASHVE's Heating, Ventilating, Air Conditioning Guide below 71 deg effective is in error (in my opinion) if you are talking about "healthful" conditioning for comfort.

In summer cooling, the panel heat effect of sun on walls, glass blocks, or roofs is important and here again our literature is silent. Add high intensity illumination on a ceiling to sun load on a roof and you have a very effective panel heater. If the conditioning air is brought through the perforated ceiling method of distribution, you directly absorb this heat.



ASHVE Comfort Chart for Still Air

[From Heating, Ventilating, Air Conditioning Guide 1947, Chapt. 12]

***Note.*—Both summer and winter comfort zones apply to inhabitants of the United States only. Application of winter comfort line is further limited to rooms heated by central station systems of the convection type. This line does not apply to rooms heated by radiant methods. Application of summer comfort line is limited to homes, offices and the like, where the occupants become fully adapted to the artificial air conditions. The line does not apply to theaters, department stores, and the like where the exposure is less than 3 hr. The optimum summer comfort line shown pertains to Pittsburgh and to other cities in the northern portion of the United States and Southern Canada, and at elevations not in excess of 1000 ft above sea level. An increase of 1 deg ET should be made approximately per 5 deg reduction in north latitude**

It seems to me that the time has come seriously to consider air conditioning for health. If we do not know what these conditions are, we should find out. A good starting point would seem to be to pick up all of the information that was developed during the war by the Army and Navy and others who were running tests on people in laboratories and in the field. We should also pick up work of this kind which has been done in hospitals and medical schools either before, during, or after the war so that our literature can embrace the best that has been done and so that the designer who wants to furnish healthful air conditioning will have something on which to base design.

Prepare Standards for City, State Codes

The next step would be to prepare and offer standards that can be used by city, state, and national bodies who are now enthusiastically writing all sorts of codes on the subject of heating and ventilating. Unless some accurate information is given to them we are apt to have poor codes and poor conditioning.

If it should be found that there is need for further laboratory study on certain phases, the ASHVE research laboratory could undertake such study if it had proper facilities. These it does not have, and I doubt if it would want to put the money into psychrometric rooms of the proper type to do a research job. Possibly the research facilities that have been prepared by others could be used, and by furnishing staff and supervision the ASHVE could get the information needed at reasonable cost.

One further step would be to run field studies conducted by scientists who will measure and note the various effects of panel heating and cooling as well as effective temperatures and will come up with factual information and not confirmation of preconceived notions.

LESTER T. AVERY discusses here the much-discussed subject of what the proper temperatures and humidities are for winter and summer air conditioning. He believes we should abandon the word "comfort," and seriously consider instead air conditioning for health. If we don't know what the healthful conditions are, we should undertake research to find out

If it is true that 300 girls working side by side in a conditioned space would not notice a change in temperature from 73 deg effective to 70 deg effective when the relative humidity changed from 80 to 20 percent and skin temperature remained at 94 deg, we would have corroboration of Yaglou's claim as determined from *two* controlled subjects. Our experience with groups of girls working in telephone toll rooms and in manufacturing operations involving assembly of small parts for the VT fuse and finishing of crystals, indicates that you must hold humidity constant if you wish your thermostat to hold temperature constant and maintain constant healthful conditions. One assembly room was set at 78 F and 35 percent and held there for the benefit of the product—nothing to do with people or comfort. Hundreds of girls worked in this condition day after day year around—that is, 71 deg effective—and we had no complaints of shock when passing to and from in hot weather nor was it considered overheated in cold weather.

Our observation is that effective temperatures must tie in with effects of radiation and air motion and when you hit a good balance you hold it and you do not need to worry about change of season nor variations in people. Ninety-nine percent of the occupants like that condition once they get adjusted to it, and the others are sick!—Lester T. Avery, president, Avery Engineering Co., Cleveland.

LOOSE-LEAF NOTEBOOKS FOR DATA FILE

In reply to "R.A.W." on his question on filing articles from Heating, Piping & Air Conditioning and other magazines, I suggest the following:

The method of filing I use is to cut up the old magazines and arrange the articles in loose-leaf fashion in a three ring notebook. This requires some cutting and pasting and not all articles can be saved without doing some typing on parts of them. When I find pages that are too narrow in the margins for punching holes, I put an extension on them with paper tape about 1 in. wide and folded to make a double thickness for punching the holes.

"OPEN FOR DISCUSSION"

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At the beginning of each section I put an index tab for ready reference. In this manner I am able to file several sections in each loose-leaf notebook. The sections may be arranged in alphabetical order; book one would include sections from A through F and book two would begin with section G, etc.

If a more extensive index is desired I suggest that a 3 by 5 in. card index be made showing which book contains the section under which the particular article is filed.—S. H.

AIR COMPRESSOR STANDARD

A revision of simplified practice recommendation R202-43, Air Compressors for Automotive Service Stations and Garages, as proposed by the original proponents of that program, has been submitted to the manufacturers, distributors, and users of air compressors for comment or approval, or both.

The proponents of this program decided that the title should now be designated as Tank Mounted Air Compressors (¼ to 10 Horsepower) to enable the industry to coordinate this proposed revision of air compressors with the commercial standard CS 126-45 on the same subject.

It is desirable that as many firms as possible be given an opportunity to examine this proposed recommendation. Therefore, readers of this announcement are invited to make known their interest by writing to the Commodity Standards Division, National Bureau of Standards, Washington 25, D.C.

Graphitization of Steel at Elevated Temperatures

THE STABILITY of 93 different types of steel at exposure temperatures of 900, 1050, and 1200 F for various time periods up to 100,000 hr is being evaluated with respect to the influence of chemical composition, steel making process, deoxidation practice, heat treatment, etc. Due to the association of graphite with welded structures, this factor was given special consideration. Weld beads of differing heat inputs were deposited on opposite sides of a 1 in. square bar representing each steel condition. In addition to the weld bead test specimens, other bars were exposed at the three temperatures primarily for the evaluation of creep rupture strength after exposure.

The present paper discusses some of the graphitization results obtained after an exposure period of 10,000 hr. The program as a whole will include a study of creep and creep rupture characteristics of the steels before and after exposure, oxidation loss during exposure, determination of the effect of prolonged exposure on impact strength, and the structural changes that take place at 900-1200 F over a period of 11 yr. Results of the latter studies will be presented as the data become available.

Carbon, carbon - molybdenum, chromium-molybdenum, molybdenum-vanadium, and nickel steels were included in this investigation. Bessemer, open hearth and electric furnace steels were represented. As the use of aluminum in deoxidation practice influences the behavior of various steels with respect to graphitization, this phase of steel making was thoroughly evaluated. With reference to the chromium-molybdenum steels, the addition of titanium, columbium, phosphorus, and silicon were included. The austenitic grain size of the steels was determined, as the results of other investigations have shown that this, as well as the degree of abnormality, is a possible factor in graphitization. The residual alloy content of various steels was also considered, as this may have a bearing on graphitization. The steels selected were forged to 1 x 1 x 6 in. bars and surface ground. Individual types of steels were given a normalize, normalize and draw, and anneal heat treatment according to their respective grade and composition.

Early in the program the need for a standardized method for rating graphite was recognized. It was apparent that a photographic record of all samples would be impractical and difficult to summarize in a report. Graphite rating charts were developed which define sizes of graphite particles. The number and type of particles are not shown on the charts, but these variables are introduced in the graphite rating employed. An "f" factor is also shown on the charts which indicates the cubic inches of graphite in one particle at x 500. This factor may be used for evaluating the volume of graphite present. The product of the number of nodules and the index factor for a given nodule size provide a relative graphite volume rating.

Although this system offered a simple means for rating the 1000 hr samples, examination of some of the samples exposed longer disclosed that the distribution and size of graphite varied considerably across the weld-heat affected zone. To evaluate this variation in distribution of graphite and portray a picture of the type and amount of graphite associated with weld beads, it was necessary to rate each sample in several regions. All weld bead samples, therefore, were rated as follows: Zone 1, in the coarsened grain structure immediately beneath the weld metal; Zone 2, in the relatively fine grain structure beneath Zone 1; Zone 3, near the boundary of the heat affected zone where the ferrite grain size is similar to the parent metal; and Zone 4, in the unaffected parent metal.

In general, there has been little difference noted between the two weld bead sizes in so far as graphitization characteristics are concerned. There appeared to be a general trend for the large bead to show a slightly greater amount of graphite, but the difference was relatively slight and not always consistent. Results from the small weld bead are discussed in this report.

The conclusions, based on 10,000 hr exposure at 900, 1050, and 1200 F are as follows:

1) Undeoxidized (capped) steels and, in particular, capped acid bessemer steel, exhibited remarkable resistance to graphite formation.

2) Deoxidized acid bessemer steels exhibited no greater tendency to graphitize than deoxidized basic open hearth steels.

3) All of the deoxidized carbon steels graphitized after 10,000 hr exposure. The period of incubation before graphitization and the rate of graphitization were related to the deoxidation practice.

4) Steel containing 0.50 percent molybdenum deoxidized with silicon and large amounts of aluminum graphitized after 10,000 hr exposure. Similar steels deoxidized with silicon or silicon and small amounts of aluminum did not graphitize.

5) Steels with 0.50 percent molybdenum deoxidized with silicon and a large amount of aluminum were not immune to graphitization after the addition of 0.25 percent chromium.

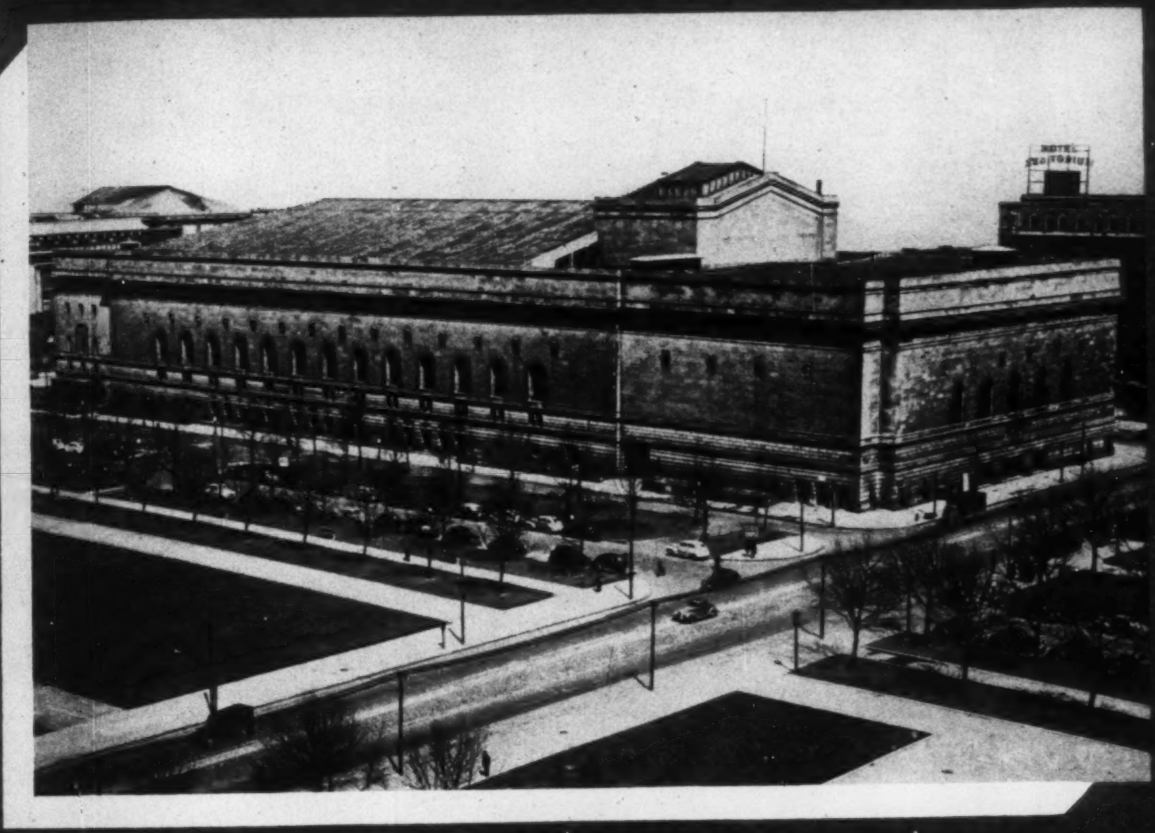
6) Chromium-molybdenum steels with 0.50 percent or more chromium, regardless of the deoxidation practice, have not graphitized after 10,000 hr at 900, 1050, or 1200 F.

7) Steel with 1 percent molybdenum and 1.50 percent molybdenum steels with 0.16 percent vanadium graphitized after 10,000 hr exposure at 1050 F.

8) Steel containing 3.7 percent nickel and another containing 0.38 percent carbon, 1.7 percent nickel and 0.26 percent molybdenum graphitized after 1000 hr at 1050 F. Steel with 5.2 percent nickel showed no graphite at 1000 hr, but very large nodules after 10,000 hr at 1050 F.

Condensation of a paper presented by A. B. Wilder, chief metallurgist, National Tube Co., United States Steel Corp. Subsidiary, and J. D. Tyson, metallurgical dept., Lorain Works, of the same company, at the National Metal Congress sponsored by the American Society for Metals, October 1947.

SHOW SECTION



Cleveland

January 26-29

The Fifth All-Industry Refrigeration and Air Conditioning Exposition, Public Auditorium, Cleveland, Ohio, sponsored by the Refrigeration Equipment Manufacturers Association

F. J. Hood, chairman of the REMA show committee, shown at a recent meeting going over plans for the Fifth All-Industry Refrigeration and Air Conditioning Exposition with representatives of three of the cooperating associations—Gerald W. Weston, executive vice president, National Association of Refrigeration Contractors; Alfred Chadburn, assistant secretary, American Society of Refrigerating Engineers; and James H. Downs, show committee chairman, Refrigeration Equipment Wholesalers Association

Refrigeration and Air Conditioning Show Opens in Cleveland January 26

WHEN THE CURTAIN rises January 26 on the Fifth All-Industry Refrigeration and Air Conditioning Exposition in Cleveland's Public Auditorium, it will reveal two acres of displays and demonstrations. The four-day show is sponsored by the Refrigeration Equipment Manufacturers Association.

More than 200 exhibitors will have presentations, and the exposition promises to be every bit as large as the 1946 show in Cleveland. More than 5000 pieces of equipment were exhibited at that show, and the value of displays and costs of company participation were placed at $2½ million.

During the period of the show, January 26-29, which is expected to attract close to 20,000 visitors, associations and other industry groups are scheduling many meetings and gatherings. According to show officials, if hotel reservations have not been made, this should be done immediately through the Convention and Visitors Bureau, Terminal Tower, Cleveland, Ohio.

With the 1948 exposition, REMA inaugurates a new, long-range program of biennial expositions, and the Sixth All-Industry Exposition is scheduled for Cleveland during the week of November 7, 1949.

Hotel assignments for the 1948 show are as follows: REMA, Hotels Cleveland and Carter; exhibitors, both members and non-members of REMA, Hotels Cleveland and Carter; National Association of Refrigeration Contractors, Hotel Allerton; National Commercial Refrigerator Sales Association, Hotel Auditorium; Refrigeration Equipment Wholesalers Association, Hotel Statler; and Refrigeration Service Engineers Society, Hotel Hollenden.

The exposition halls will be open to the entire industry on Monday, January 26 from 2 to 10 p. m., January 28 from noon to 6 p. m., and January 29 from 10 a. m. to 4 p. m. They will be open exclusively to refrigeration contractors, dealers, and service engineers from noon to 6 p. m. on January 27, and there will be a "preview" for wholesalers only on January 26 from 10 a. m. to 2 p. m. The show will not be open to the general public.

"PREVIEW" OF AIR CONDITIONING EXHIBITS

MANY of the exhibits at the Fifth All-Industry Refrigeration and Air Conditioning Exposition will display equipment of particular interest to air conditioning engineers and contractors, and this "preview" of the show has been restricted to such exhibits. Inquiries were sent to all exhibitors as listed by the exposition management on our press date, and those listed here with information on the products they will display and the names of their representatives in attendance furnished these details direct to Heating, Piping & Air Conditioning. With the booth numbers, and the accompanying diagram of the exhibit space, the location of each exhibitor can be quickly spotted.

ACME INDUSTRIES, INC., 618 N. Mechanic St., Jackson, Mich.—Booth 604.
In attendance: G. M. Comstock, A. H. Munro, J. P. Blanchard, J. M. Craun, E. P. Craun, L. J. Freitas, J. W. Snyder, G. G. Schultz, R. F. McAndrews, N. B. Anderson, E. R. Magnus, L. S. Pawkett, H. S. Ryan.
Exhibiting: Shell and tube condensers, shell and coil condensers, evaporative condensers, "Dry-Ex" water chiller, forced convection units, heat exchangers, oil separators. Featuring model "AP/FP" evaporative condenser, new "Blo-Cold" unit (forced convection).

AIRSERCO MFG. CO., INC., 435 Melwood St., Pittsburgh 13, Pa.—Booth 424.
In attendance: Emmett C. Williams, George F. Ullum, Allison Sharp, H. M. Williams.
Exhibiting: Instruments, equipment, parts. Featuring electric portable evacuator, hermetic unit starter and analyzers, refrigeration calculators.

AIRTEMP DIV. OF CHRYSLER CORP., 1119 Leo St., Dayton 1, Ohio.—Booths 103 and 105.
In attendance: H. A. Malcom, W. B. Shirley, A. F. Ward, M. T. Bard, G. S. Cobb, E. A. Ham, S. A. Anderson, Jr., W. C. Bartels.
Exhibiting: Complete lines of air conditioning and commercial refrigeration products; "packaged" air conditioners; year 'round air conditioner; various sealed radial compressors, etc. Complete air cooled condensing units will be featured.

ALCO VALVE CO., 865 Kingsland, St. Louis 5, Mo.—Booth 608.
In attendance: R. P. Kipp, A. L. Baker, C. F. Cooley, August Ulbert, B. W. Rist, C. W. Alcott, G. J. Boepple, L. K. Wright, Jr., W. B. Knox, J. A. Schenk, R. B. McCrady, L. J. Freitas, R. N. Meyer.
Exhibiting: Complete line automatic refrigerant control devices.

ALUMINUM COMPANY OF AMERICA, 801 Gulf Bldg., Pittsburgh 19, Pa.—Booth 518.
In attendance: John R. Willard, and sales and development representatives.
Exhibiting: "Alcoa" aluminum ducts, tubing, activated alumina for dehydration. Welding and brazing operations used in the air conditioning and refrigeration industry will be illustrated.

AMERICAN BRASS CO., Waterbury 88, Conn.—Booth 217.
Exhibiting: Products of two of its specialty branches, the French Small Tube Branch and the American Metal Hose Branch. The French Small Tube Branch exhibit will have, as its main feature, "Anaconda" dehydrated copper refrigeration tubes. These tubes in standard sizes and standard length coils are manufactured under precision control and "unusually clean" plant conditions. They are hermetically sealed with the cup seal. Other products will be capillary tubing of extremely small diameters, which will be shown in a single unjointed coil 2500 ft in length. There will also be fabricated and formed tubing. The American Metal Hose Branch products will include "American" vibration eliminators, which have become "standard equipment" for air conditioning and refrigeration installations. Another comparatively new product will be refrigeration charging hose. There will also be a display of types K and L copper water tubes with a selection of cast bronze and wrought copper solder fittings and cast bronze flared tube type fittings.

AMERICAN FLANGE & MFG. CO. INC., 30 Rockefeller Plaza, New York 20, N. Y.—Booth 1112.
In attendance: Norman O. Hommert, Daniel J. Alesio.
Exhibiting: "Ferro-Therm" steel insulation: for homes, commercial buildings, and refrigerated structures. Features will be a "Hot Box" which illustrates the insulating power of one thin sheet of steel insulation, and the new preformed "Pen-Shaped Ferro-Therm" for easy, economical application.

AMERICAN INJECTOR CO., 1481 14th St., Detroit 16, Mich.—Booth 126.
In attendance: Ed Kellie, John L. Trix, G. I. Boone, G. B. Boone, J. C. Battles, W. Cody, Allan Cody, Van D. Clothier, J. D. Ross, A. E. Doane.
Exhibiting: Oil separators, snap action valves, constant pressure valves, water valves, high side floats, starting load regulating valves, check valves (line), loaded check valves, flange adapters, pressure-vacuum setting pumps, water strainers, etc.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, 40 W. 40th St., New York 18, N. Y.—Booth 1204.
In attendance: M. C. Turpin, Alfred Chadburn.
Exhibiting: Publications.

ANSUL CHEMICAL CO., Stanton St., Marinette, Wis.—Booth 713.
In attendance: H. V. Higley, F. J. Hood, R. C. Hood, L. C. McKesson, G. B. Vermilye, L. T. Plouff, Dr. W. O. Walker, W. R. Rinelli, F. W. Wedge, K. B. Covert, R. F. Polley, F. M. Duvall, R. Meuer, E. M. Billings, R. C. McNeely, Herb Dill, T. R. Kearney, D. Hardie.
Exhibiting: A collection of solids formed by chemical or physical reaction and taken from refrigeration systems will be displayed.

ARMSTRONG CORK CO., Lancaster, Pa.—Booth 409.
In attendance: H. B. Wentz, R. B. Breneman, A. G. Klein, John S. Taylor, B. W. Adams.
Exhibiting: Corkboard, "Foamglas," mineral wool board, cork covering. Featuring construction and specification details in connection with these products.

AUTOMATIC PRODUCTS CO., 2450 N. 32nd St., Milwaukee 10, Wis.—Booth 504.
In attendance: E. A. Vallee, D. Moerick, Bradley T. Carroll, A. L. Neva, Jack F. Cowan, John W. Hall, Donald They, Richard E. Morton, John F. Gibbs, J. E. Hutchinson, Wm. H. Cody, Allan Cody.
Exhibiting: Expansion valves, water valves, solenoid valves, thermostatic expansion valve with pressure limiting feature.

BAKER ICE MACHINE CO., INC., South Windham, Maine.—Booth 506.
In attendance: Ross Rathbun, Charles Knox, A. J. Mallinckrodt, H. D. O'Rourke, H. C. Hickock, W. W. Woodroof.
Exhibiting: "Freon" and ammonia refrigerating equipment, including open type compressors, complete compressor units, complete condensing units. Component parts of the equipment will be displayed in order to show construction features.

BALTIMORE AIRCOIL CO., INC., 402 Colvin St., Baltimore 2, Md.—Booth 1212.
In attendance: John Engalitcheff, Jr., Ray R. Forseille.
Exhibiting: New model of centrifugal fan condenser featuring reversible fan section with angular discharge, reversible bottom section, extreme accessibility to all working parts including condensing coil; manufactured in sizes from 10 to 100 tons in increments of 5 tons. Propeller fan condenser, a special development for outside installation featuring extreme accessibility, ease of maintenance, counterflow heat transfer, low horsepower consumption; manufactured in sizes from 10 to 50 tons in increments of 5 tons. "Jr." evaporative condenser, a new line built in 3, 5, 7½ tons capacity. Liquid receivers.

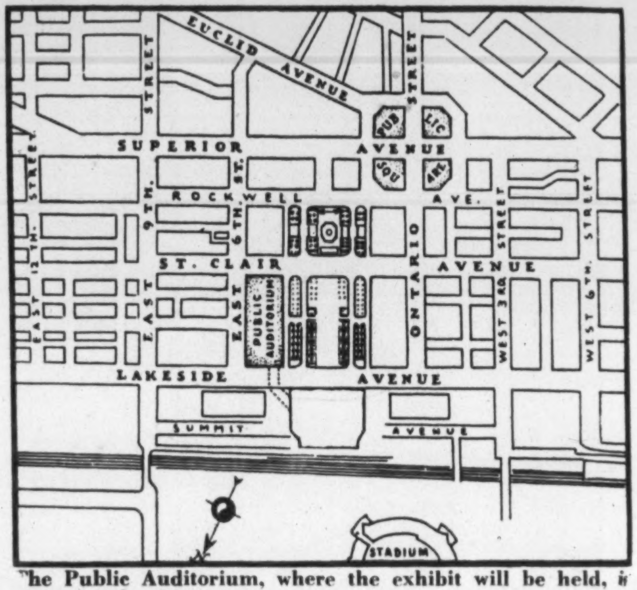
BERRY MOTORS INC., 2111 Sterick Bldg., Memphis, Tenn.—Booth 1122.
In attendance: Kingsley W. Hooker, Harrell F. Jeanes, Eve Edgerley.
Exhibiting: Rotary vaneless "Freon" compressor. This unit has never before been exhibited. It has a "low initial cost, few parts, low friction, high efficiency, low maintenance cost."

BETZ CORP., 445 State St., Hammond, Ind.—Booth 609.
In attendance: Lyman B. Betz, V. C. Knight, R. W. Schreiber, H. Gullatt, John Blumhardt.
Exhibiting: Complete line of "Filterpure" cooling units for commercial refrigeration, totalling approximately 12 distinct models.

BONNEY FORGE & TOOL WKS., Tilghman and Meadow Sts., Allentown, Pa.—Booth 328.
In attendance: C. D. Otterson, F. S. Durham, Jr., D. E. Tuttle, O. W. Cadle, C. A. Macan, H. D. Wixson, Jr.
Exhibiting: Refrigeration service hand tools.

BRUNNER MFG. CO., 1821 Broad St., Utica 1, N. Y.—Booths 304, 306, 308.
In attendance: G. L. Brunner, A. G. Zumbrun, J. W. Thomas, O. R. McDonald, and all territory managers.
Exhibiting: Condensing units, ¼ to 3 hp air cooled, 1/3 to 25 hp water cooled, featuring new refinements in design.

BUNDY TUBING CO., 8109 E. Jefferson Ave. at Parker, Detroit 14, Mich.—Booth 407.
In attendance: G. D. Baker, P. A. O'Connell, J. A. Dugan, H. L. Millett.
Exhibiting: Display explaining the process by which "Bundyweld" steel, monel, and nickel tubing is manufactured, and an exhibit of samples of tubing parts used in the refrigeration and air conditioning industry.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ROCKWELL AVE.
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LAKESIDE AVENUE
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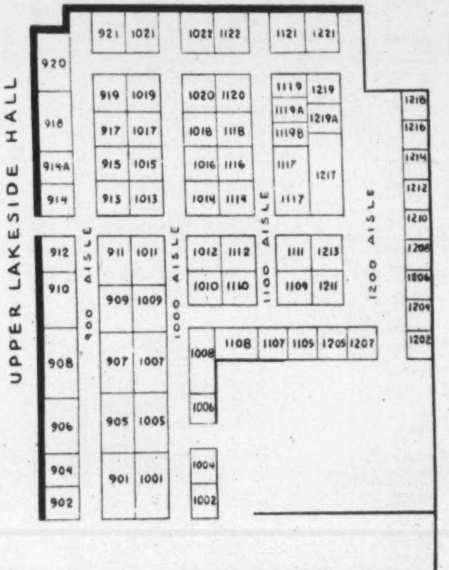
EAST 9TH. STREET
EAST 6TH. ST.
ONTARIO STREET
WEST 3RD. STREET
WEST 6TH. STREET
PUBLIC
PUBLIC AUDITORIUM
STADIUM

he Public Auditorium, where the exhibit will be held, i conveniently situated

This diagram shows booth numbers for the Fifth All-Industry Refrigeration and Air Conditioning Exposition to be held at the Cleveland Public Auditorium, January 26-29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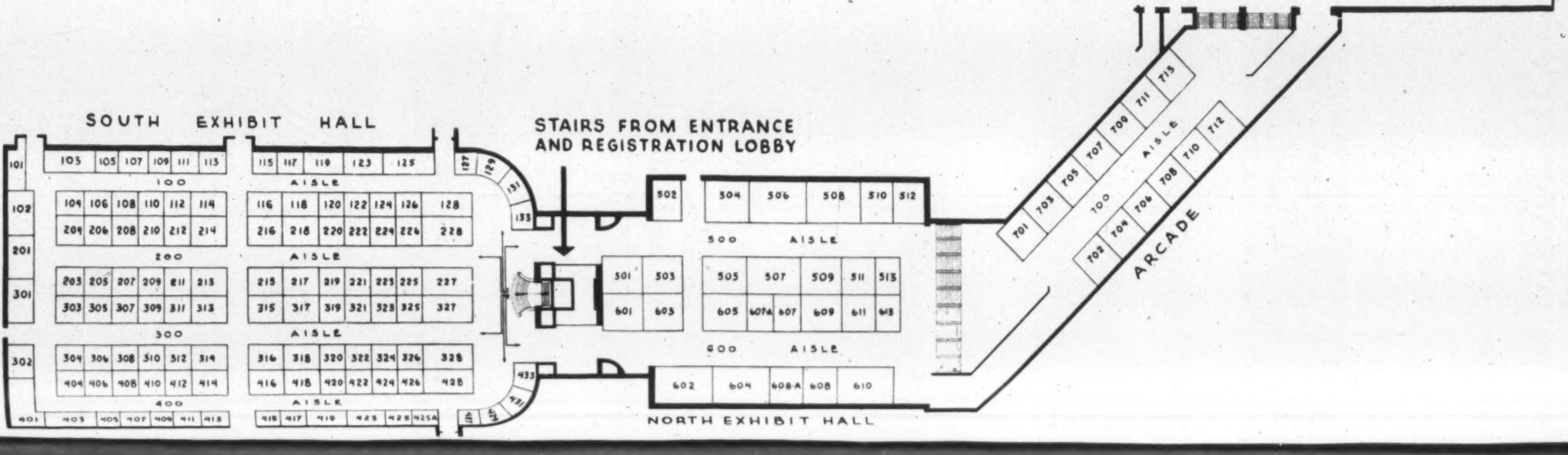
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BUSH MFG. CO., 1031 New Britain Ave., Hartford 10, Conn.—Booth 610.

CENTURY ELECTRIC CO., 1806 Pine St., St. Louis 3, Mo.—Booth 36B.
In attendance: R. J. Russell, J. L. Woodress, E. S. Moore, G. C. Henderson, Anthony Neher, Al Smith, I. S. Adelberg, W. H. Moore, R. L. Biller, J. S. Jervis, Geo. Pechin, M. L. Downing, Oliver S. Imes, Robert F. Englich, C. H. Lankford.
Exhibiting: Motors—single phase, polyphase, direct current, open, splashproof, totally enclosed, totally enclosed fan cooled, explosion proof.

CHICAGO SEAL CO., 20 N. Wacker Dr., Chicago 6, Ill.—Booth 323.
In attendance: Herman Goldberg, Willis Stafford, D. D. Orr, R. E. Cook, Felix Wierman.
Exhibiting: Valve plates, seals.

CLEVELAND GRAPHITE BRONZE CO., 17000 St. Clair Ave., Cleveland 10, Ohio—Booth 921.
In attendance: L. W. Christenson, Arthur E. Gibbs, Charles A. Smythe.
Exhibiting: Bearings and bushings of various types for refrigerating equipment. Projected slides will show "world's finest" plant for manufacture of sleeve type bearings and bushings.

COPELAND REFRIGERATION CORP., Sidney, Ohio—Booths 703 & 705.
In attendance: H. E. Thompson, F. J. Gleason, O. H. Buschmann, C. L. Curtis, W. G. von Meyer, R. G. Berg, G. L. Hickey, Jr., Bert Kaple, W. J. Galvin, G. W. Chandler.
Exhibiting: Commercial refrigerating units—1/6 to 3 hp air cooled, 1/3 to 7½ hp water cooled. Featuring heat pumps for residential heating and cooling.

CURTIS REFRIGERATING MACHINE DIV. of CURTIS MFG. CO., 1905 Kienlen Ave., St. Louis 20, Mo.—Booths 210-212-214.
In attendance: K. T. Rockey, Geo. C. Helde, C. W. Stover, M. C. Jones, N. H. Behrend, F. J. T. Stock, G. W. Schultz, H. J. Nettler, H. C. Morrison, A. C. Kniseley.
Exhibiting: 3, 5, and 10 ton packaged air conditioning units; air and water cooled commercial condensing units; operating model demonstrating patented pressure compressor lubricating system. All of this equipment has been completely redesigned and modernized.

CUTLER-HAMMER, INC., 315 N. 12th St., Milwaukee 1, Wis.—Booth 128.
In attendance: P. S. Jones, R. M. Van Vleet, R. J. Eckstein, W. Stark, L. P. Niessen, W. R. Reinhold, J. P. Simon, E. A. Clark, C. W. Greenman, R. A. Volbrecht, M. Dugliss, A. M. Wolf, D. S. Galbraith, W. E. Leffingwell, H. H. Ratcliff, C. L. Wymelenberg.
Exhibiting: Refrigeration controls—custom built, exact replacement, and general replacement; motor control equipment and accessories for refrigeration and air. conditioning. A new thin model refrigeration controller for breaker strip or liner mounting will be featured.

DAVISON CHEMICAL CORP., 20 Hopkins Pl., Baltimore, Md.—Booths 311 and 313.

DAY & NIGHT MFG. CO., 710 Duarte Ave., Monrovia, Calif.—Booth 225.
In attendance: J. W. Rubenson, H. J. Ferris.
Exhibiting: Commercial and industrial water cooling equipment.

DAYTON RUBBER CO., 2342 W. Riverview Ave., Dayton 1, Ohio.—Booths 415 & 417.
In attendance: K. L. Bohler, W. J. Michel, J. T. Wilson, K. R. Van Doren.
Exhibiting: V belts, featuring new construction with rayon cord which "provides minimum stretch, greater flex strength and longer v-belt life."

DETROIT LUBRICATOR CO., 5900 Trumbull Ave., Detroit 8, Mich.—Booths 503 & 603.
Exhibiting: Complete line of expansion valves, solenoids, and refrigeration controls.

DOLE REFRIGERATING CO., 5910 N. Pulaski Rd., Chicago 30, Ill.—Booth 605.

DU PONT DE NEMOURS & CO., E.I., Wilmington 98, Dela.—Booth 414.
In attendance: Geo. Courtney, Arthur Cole, Newton Beck, Richard Ballman, Joseph Moore, C. B. Shepherd, P. R. Hendrixon, N. C. Cooper, V. J. Zaffke.
Exhibiting: "Artic" methyl chloride, "Freon," sulfur dioxide.

ELECTRIC POWER EQUIPMENT CORP., 412 N. 18th St., Philadelphia 30, Pa.—Booth 1007.
In attendance: M. E. Miller, R. H. Shanaman, Adam Becker, W. E. Ural, L. Smith, M. J. Meiklejohn, S. C. Moncher, F. J. Marshall, Alvin Dattle, A. A. Aldridge, W. H. Cooper, Jr.
Exhibiting: 1/6 to 2 hp air cooled condensing units, ½ to 2 hp water cooled condensing units, ½ ton window cooler, ¾ and 1½ ton console model self-contained air conditioning unit, unit coolers, heat exchangers, thermostatic valves, "Thermek." The ½ ton window cooler and the ¾ ton console model air conditioning unit will be featured.

ELECTRIMATIC DIV., SIMONIZ CO., 2100 Indiana Ave., Chicago 16, Ill.—Booth 215.

ESTON CHEMICALS, INC., 3100 E. 26th St., Los Angeles 23, Calif.—Booth 224.
In attendance: G. S. Wheaton, W. E. Horn.
Exhibiting: Methyl chloride, sulfur dioxide.

FEDDERS-QUIGAN CORP., 57 Tonawanda St., Buffalo 7, N. Y.—Booth 403.

FRIGIDAIRE DIV., GENERAL MOTORS CORP., 300 Taylor St., Dayton 1, Ohio.—Booth 1217.
In attendance: J. B. Nahstoll, W. F. Switzer, A. C. Freimann, G. A. Hayner, C. F. Wood, M. C. Schenck.
Exhibiting: Store air conditioner, forced air cooling unit, and compressors, and featuring a large printed replica of the new commercial "Meter-Miser" condensing unit in operation.

GENERAL CONTROLS CO., 801 Allen Ave., Glendale 1, Calif.—Booth 314.
In attendance: J. F. Ray, John M. Schlemmer, Ed Maire, and others.
Exhibiting: Electrical solenoid stop valves for all refrigerants, thermostatic expansion valves, water valves, pressure and temperature controls.

GENERAL ELECTRIC CO., Apparatus Dept., 1 River Rd., Schenectady 5, N. Y.—Booths 115 & 117.
In attendance: N. L. Parker.
Exhibiting: Fractional horsepower and "Tri-Clad" motors, control transformers, switch panel, new portable halogen leak detector.

GENERAL ENGINEERING & MFG. CO., 4417 Oleatha, St. Louis 16, Mo.—Booths 315, 317, 319.
In attendance: Norman Schreiber, Ray Brenner, J. Y. Hewitt, F. H. Eldredge, A. M. House, Ernest Gygax, Arthur Huhn, John H. Schreiber, Pete Becker, C. H. Fox, C. J. LeMaster, M. W. Nerius, Chas. J. Davis, H. B. Osmundsen, James Lamb, Andy Love.
Exhibiting: 3 and 5 ton "Gemco" packaged air conditioning units, and featuring the "Miracula" heat pump unit.

GILMER CO., L. H., Div. of United States Rubber Co., 7230 Keyston St., Tacony, Philadelphia 35, Pa.—Booth 1010.
In attendance: L. K. Youse, H. B. Allison, E. F. Wood, H. W. Weihenmayer, W. F. David, N. R. Chapman, W. E. Mettler, R. L. Bentz, G. A. Grone.
Exhibiting: V belts and electric wire cord sets and wire on spools.

HALSTEAD & MITCHELL, Bessemer Bldg., Pittsburgh 22, Pa.—Booth 425.
In attendance: Byron Halstead, Fred Halstead, William Rapp, D. Gentry, Thomas Scott, Charles Wilmes, Hugo Smith, Wilton L. Ledbetter, Merle G. Haynes.
Exhibiting: Double tube, counterflow, cleanable, water cooled condensers; water chiller—new self-contained 5 ton water cooling unit with a cleanable feature specifically designed for industrial water cooling; marine condenser for marine application.

HEATING, PIPING & AIR CONDITIONING, 6 N. Michigan Ave., Chicago 2, Ill.—Booth 1119-A.
In attendance: Chas. E. Price, Wallace J. Osborn, Robert A. Jack, George C. Cutler, James D. Thomas.
Exhibiting: Publication, technical books, market data.

HEAT-X-CHANGER CO., INC., Brewster, N. Y.—Booth 125.
In attendance: Cecil Boling, L. G. Underhill, W. J. Donovan, R. A. Chadburn.
Exhibiting: Heat exchangers.

HENRY VALVE CO., 3260 W. Grand Ave., Chicago 51, Ill.—Booth 227.
In attendance: Richard S. Dawson, C. W. Hudzietz, J. Endweiss, H. F. Stamps, D. R. Byth, C. H. Boyd, A. A. Ways, N. Beals, E. A. Flesh, G. W. Wheeler.
Exhibiting: valves—packless, valves—ammonia, valves—solenoid, driers, strainers, drier-strainer combinations, valves—pressure regulating, valves—liquid gage, combination drier-accumulator, float switch. Features are all types of solenoid valves, pressure regulating valves, special beverage vending machine devices, the float switch, and special filters using sintered metal as the filtering medium.

HIGHSIDE CHEMICALS CO., 195 Verona Ave., Newark 7, N. J.—Booth 321.
In attendance: Laurence V. Gardner, Harry M. Katon, A. W. Barber, Merle G. Haynes, Joe E. Parker, L. D. Greenwood.
Exhibiting: "Thawzone" and "Trace."

HUDSON PRODUCTS CO., INC., 4400 St. Aubin, Detroit 7, Mich.—Booth 502.
In attendance: James L. Hudson, John F. McGuire, Charles W. Hall, E. W. Fraser, Raymond B. Hill, Philip F. Bender, Ludwig Stromayer.
Exhibiting: Plastic tubing.

IMPERIAL BRASS MFG. CO., 1200 W. Harrison St., Chicago 7, Ill.—Booths 426 & 428.
In attendance: G. Duerr, F. Wilson, K. Waugh, T. Fuite, T. Byrnes, A. Mitchell, M. Mitchell, C. H. Benson, E. F. Todd, G. Franck, R. McIntosh, J. Greenlee, J. Dlesk.
Exhibiting: Filters, valves, fittings, driers, tube working tools, floats, charging and testing equipment, liquid indicators, and welding and soldering equipment.

JACK & HEINTZ PRECISION INDUSTRIES, INC., Cleveland 1, Ohio—Booth 908.
In attendance: Larry Breck, Larry Anderson, Frank Haag, Wm. Davis, John McKinley, C. C. Clarke, Earl Moyse, Bud Gibbons.
Exhibiting: ¼, 1/3, and ½ hp open-type condensing units; 1/10 hp hermetic condensing unit.

KELVINATOR DIV., NASH-KELVINATOR CORP., 14250 Plymouth Rd., Detroit 32, Mich.—Booths 901 and 1001.
In attendance: R. G. Alexander, T. G. Ammel, G. T. Etheridge, B. Fury, E. G. Haight, C. H. Herrlich, G. R. Kingston, J. B. Legler, H. K. Leussler, J. E. Oertel, H. P. Patterson, E. A. Seibert.
Exhibiting: Condensing units (sealed and open types); refrigeration parts.

KEROTEST MFG. CO., 2525 Liberty Ave., Pittsburgh 22, Pa.—Booths 220 & 222.
In attendance: G. R. Allen, H. M. Jones, R. W. Mueller, Jr., Austin Jones, Karl Berquist, Joe Blake, Al Harvey, Leo Freitas, J. A. Norris, Wilson Meek, Paul O'Brien, R. W. Gripp.
Exhibiting: Refrigeration and air conditioning valves, fittings, and accessories. Featuring several new products, including charging stand, in-line two-way valve, integral forged manifold, variable bolt hole compressor valve, lightweight globe valve.

KINETIC CHEMICALS, INC., 10th & Market Sts., Wilmington 98, Dela.—Booth 216.

In attendance: R. J. Thompson, R. L. Williams.
Exhibiting: "Freon" refrigerants.

KRAMER TRENTON CO., North Olden & Breunig Aves., Trenton 5, N. J.—Booths 116 and 118.

In attendance: S. Charles Segal, Harry Klingler, Israel Kramer, Nathan Kramer, Frank C. Obert.
Exhibiting: New coil designs; new design and application of fractional horsepower fan duty type evaporators; extra large ceiling type evaporators; "major innovation" of the radial unit cooler, details to be announced at the show; working model of "Thermobank," illustrating the automatic defrost for low temperatures; new design of air cooled condenser.

LARKIN COILS, 519 Memorial Drive, S.E., Atlanta 1, Ga.—Booths 710 and 712.

In attendance; O. M. Sims, S. D. Hughes, C. L. White, J. E. Palmer, E. A. Gustafson.
Exhibiting: Fin coils, blower units, air conditioning units, evaporative condensers, floor model blower unit, heat exchangers, bare tube coil.

LEWIN-MATHES CO., 1111 Chouteau Ave., St. Louis 2, Mo.—Booth 1022.

In attendance: Alan "Bud" Lewin, Larry Powell.
Exhibiting: Refrigeration copper tube.

LIBERTY MOTORS & ENGINEERING CORP., Coolidge & Constance Aves., Arbutus, Baltimore 29, Md.—Booth 1207.

In attendance: H. A. Loebel, Anthony Easton.
Exhibiting: Packaged "systematized" refrigeration, featuring hermetic compressors and condensing units in ¼ and 1/3 hp sizes.

LINDE AIR PRODUCTS CO., 30 E. 42nd St., New York 17, N. Y.—Booth 1114.

LYNCH MFG. CORP.—3600 Summit St., Toledo 1, Ohio.—Booths 201 and 102.

In attendance: M. H. Pendergast, J. P. McCarthy, F. K. Zimmerman, R. L. Sears, A. V. Petersen, R. R. Seibel, G. C. Davis, Wm. Gardiner, D. E. Stenson, B. J. Scholl, C. B. Pierce, B. D. Berk, E. W. Montgomery, W. A. Doepel.
Exhibiting: "Par" condensing units.

MARLO COIL CO., 6135 Manchester Ave., St. Louis 10, Mo.—Booths 404, 406, 408, 410.

In attendance: Wm. J. Bagley, A. T. Marlo, F. G. Meyer, C. D. Marlo, L. C. Pellegrini, W. B. Moses, Jr., R. C. Holsworth, Wm. C. McIntyre, H. R. Iverson, G. M. Sebree.
Exhibiting: Forced draft cooling towers, evaporative condensers, industrial type units, and unit coolers for high and low temperature applications.

MARSH CORP., JAS. P., Skokie, Ill.—Booth 114.

In attendance: Jim Emmett, Bob Burnett, Ed Kluger, Frank Zicarelli, A. C. DuPerow, Fred Hudson.
Exhibiting: Complete line of refrigeration gages and thermometers, including the "Serviceman." Also new "Duo-Temp" inside and outside thermometer.

MAYFLOWER PRODUCTS, INC., 13 S. 5th St., Richmond, Ind.—Booth 122.

In attendance: Al Green, B. D. Rinehart.
Exhibiting: 2 ton ceiling air conditioner; condensing units, ¼ hp up to 3 hp, both air and water cooled. New models, new finishes and colors and other improvements will be featured.

McCORD CORP., 2587 E. Grand Blvd., Detroit 11, Mich.—Booth 107.

In attendance: Morrill Dunn, F. W. McMillan, J. R. Hayward, E. O. Bodkin.
Exhibiting: Condensers, evaporators, fin tubing.

McINTIRE CONNECTOR CO., 263 Jefferson St., Newark 7, N. J.—Booth 611.

In attendance: L. S. Dunn, H. A. Chandler, J. G. Beierlein, George D. Metzger.
Exhibiting: Driers, filters, strainers, moisture indicator, special equipment for low temperature dehydration.

McQUAY, INC., 1600 Broadway St., N.E., Minneapolis 13, Minn.—Booth 602.

In attendance: R. J. Resch, E. H. Seelert, H. Blake Thomas, C. L. Bensen, R. N. Weber.
Exhibiting: Normal temperature and water defrost unit coolers, unit heaters, multilouver coils, round ceiling unit coolers. Featuring new wall-type unit cooler known as the "Panel Chillator."

MILLS INDUSTRIES, INC.—4100 Fullerton Ave., Chicago 39, Ill.—Booths 109 & 111.

In attendance: Harrison J. Hedrick, Hillis D. Iams, Carl L. Picker, Alexander T. Murray, Walter Babick.
Exhibiting: Condensing units, ¼ to 10 hp inclusive.

MINNEAPOLIS-HONEYWELL REGULATOR CO., 2604 Fourth Ave., S., Minneapolis 8, Minn.—Booth 701.

In attendance: W. H. Kramer, W. P. Mader, Richard Hanschen, G. M. Kingsland.

MITCHELL MFG. CO., 2525 Clybourn Ave., Chicago, Ill.—Booth 1017.

In attendance: B. A. Mitchell, E. A. Nickel, John Jennings, E. Geishert, Fred Masterson, C. Schroeder, Paul Smith.
Exhibiting: Room type and window type units.

MUELLER BRASS CO., 1925 Lapeer Ave., Port Huron, Mich.—Booths 307 and 309.

In attendance: Fred Riggin, Jr., L. Parker, John Gray, P. L. Craft, M. R. Pritchard, C. Schumann, E. F. Hall, P. O. Domke.
Exhibiting: copper tube; complete line of valves, fittings, and accessories for mechanical refrigeration, including testing manifolds, filters and strainers, driers, heat exchangers, liquid indicators, service tools; the "Little Giant" purger; featuring the recently introduced "Midget" purger for smaller systems; "Streamline" solder type fittings.

NATIONAL ASSOCIATION OF REFRIGERATION CONTRACTORS, 353 Hippodrome Annex, Cleveland 15, Ohio.—Booth 1218.

Exhibiting: Educational exhibit depicting services rendered by the association.

NEVINGER MFG. CO., INC., Greenville, Ill.—Booth 913.

OWENS-CORNING FIBERGLAS CORP., Nicholas Bldg., Toledo, Ohio.—Booth 1005.

In attendance: C. L. Rowley, J. R. McCord, E. W. Darling, Jr., Paul E. Benner, Roy Hunsaker, John Dowd.
Exhibiting: Thermal insulation, "Dust Stop" air filters.

PACIFIC LUMBER CO., 100 Bush St., San Francisco, Calif.—Booth 1208.

In attendance: Edric E. Brown, John H. Klass, Ray P. Klass, Stanley H. Dickson.
Exhibiting: "Palco Wool" insulation.

PACIFIC MFG. CORP., 5308 Blanche Avenue, S.E., Cleveland 4, Ohio.—Booth 1109.

In attendance: S. C. May, J. H. Merritt, Jr., H. C. Troth, and others.
Exhibiting: Packaged air conditioners, featuring new models for 1948 line.

SHOW HOURS

MONDAY, JANUARY 26, 1948*
2 p.m. to 10 p.m. — Open to entire industry

TUESDAY, JANUARY 27, 1948**
12 Noon to 6 p.m.
Open only to refrigeration contractors, dealers, and service engineers

WEDNESDAY, JANUARY 28, 1948
12 Noon to 6 p.m. — Open to entire industry

THURSDAY, JANUARY 29, 1948
10 a.m. to 4 p.m. — Open to entire industry

***There will be a preview for wholesalers only on Monday, from 10 a. m. to 2 p. m.**
****Though contractors and service engineers have been invited to attend on all four days, Tuesday has been set aside for them exclusively.**

PEERLESS OF AMERICA, INC., 2901 W. Lawrence Ave., Chicago 25, Ill.—Booths 707 and 709.
In attendance: M. W. Knight, W. A. Honeychurch, J. M. O'Connor, Carl Johnson, David Snow, George Francis, Roy Stuhlman, H. B. Weeks, R. L. Williams.
Exhibiting: Fin coils, flash coolers, capacity boosters, expansion valves, unit coolers, product coolers, evaporative condensers, air conditioning coils, water coils, steam coils. Featuring new air conditioning units and evaporative condensers.

PENN BRASS & COPPER CO., 20th & Powell Ave., Erie, Pa.—Booth 613.
Exhibiting: Seamless brass and copper tubing; "Papco" flaring tool; cut-off tool.

PENN ELECTRIC SWITCH CO., Goshen, Ind.—Booth 1011.
In attendance: M. E. Henning, R. H. Luscombe, K. W. Cash, B. J. Gill, C. B. Morgan, J. R. Netedu, D. G. Cameron, F. W. Hottenroth, N. E. Jennison, A. W. Barr, A. L. Rubel, R. V. Clark, W. W. Lige, L. Linehan, G. O. Sanders, O. G. Tinkey, J. Moravec, J. P. Bowen, H. D. Gray, E. M. Smith.
Exhibiting: Series "270" pressure and temperature controls (of load carrying two-pole construction), cooling room thermostats, humidistats, water regulating valves, solenoid valves.

PHILLIPS & CO., H. A., 3255 W. Carroll Ave., Chicago 24, Ill.—Booth 912.
In attendance: Grant Phillips, William Richards, Robert Bailey, Rush Langdon, George Noll.
Exhibiting: Recirculating injectors for refrigerants, valves for ammonia and "Freon," ammonia liquid line filters, precision type pressure gages in sizes from 3½ to 6 in. dial.

RANCO INC., 601 W. Fifth Ave., Columbus 1, Ohio.—Booths 310 & 312.
In attendance: G. E. Graff, W. H. Stanley, A. J. Meyer, C. M. Spielman, R. G. Raney, M. S. Vidis, A. C. Homeyer, H. M. Laird, C. E. Whipps, J. D. Merkle, C. E. Boren, F. G. Slagel, E. V. Dunbar, H. M. Goldberg.
Exhibiting: Refrigeration controls. New products to be shown will be power elements of beryllium copper.

REDMOND CO., INC., Owosso, Mich.—Booth 1211.
In attendance: R. T. Abrell, James Tweedy, W. R. Fox, L. G. Andrian.
Exhibiting: Low range fractional horsepower electric motors in sizes up to 1/15 hp, small blowers and speed controllers. Featured will be a new 1/15 hp motor with die cast frame, built in sizes up to 1/20 hp in totally enclosed models; new 1/15 hp open ventilated motor with drawn steel case; improved motors in sizes up to 1/25 hp with die cast frames.

REFRIGERATION APPLIANCES INC., 917-923 W. Lake St., Chicago 7, Ill.—Booth 1015.
In attendance: E. Niederer, J. Eichhorn, F. A. Klaas, W. A. List, Hugh D. Smart.
Exhibiting: Complete line of 1948 design low side commercial refrigeration equipment including "Freez-E-Fex" electric defrost, "Strat-E-Fex" ceiling unit, "Flo-E-Fex" wall unit, "Blo-E-Fex" floor type unit.

REFRIGERATION ENGINEERING INC., 7250 E. Slauson Ave., Los Angeles 22, Calif.—Booth 714 A.
In attendance: Hy Jarvis, W. F. Hancock, Dan D. Wile, Sterling F. Smith.
Exhibiting: New "Recold" evaporative condensers, water defrost evaporators, "Supreme" coil, "Tiny Mite Suctionair" coil.

REFRIGERATION EQUIPMENT WHOLESALERS ASSOCIATION, 920 E. McMillan St., Cincinnati 6, Ohio.—Booth 1206.
In attendance: The board of directors of the association at different intervals and H. S. McCloud, executive secretary, and Katherine S. Fisher, assistant secretary.

REFRIGERATION SERVICE ENGINEERS SOCIETY, 433 N. Waller Ave., Chicago 44, Ill.—Booth 1214.
Exhibiting: Services provided membership of this association.

REMCO, INC., Zelienople, Pa.—Booth 425.
In attendance: Kenneth M. Newcum, Walter P. Stewart, Wallace A. Henry, Hugo C. Smith, Charles W. Wilmes, Arthur K. Johnston, Thomas E. Scott, R. A. (Burt) Paton.
Exhibiting: Driers, drier-filters, filters, heat exchangers. Featuring an operating refrigeration system with new heavy duty "Cross-Flo" drier-filter arranged in the system with gages and thermometers to show effect of pressure drop through driers, and to show the effect of refrigerant temperature on drier performance.

ROTARY SEAL CO., 2020 N. Larrabee St., Chicago 14, Ill.—Booth 207.
Exhibiting: Rotary seal replacement units as sold through refrigeration parts jobbers to the refrigeration service trade.

SCHNACKE, INC., 1016 E. Columbia St., Evansville 7, Ind.—Booth 123.
In attendance: F. C. Schnacke, E. J. Miller, T. G. Thomas, Basil S. Miller, Parke Syers.
Exhibiting: 5, 25, and 50 hp condensing units; cutaway section of a compressor. A "simple and vivid" display of one of the advanced refrigeration features incorporated in their product, the refrigerant-cooled cylinder sleeve, will be featured.

SERVEL, INC., 119 N. Morton Ave., Evansville 20, Ind.—Booths 429, 431, 433.

SMITH CORP., A. O., 310 S. Michigan Ave., Chicago 4, Ill.—Booth 1219.
In attendance: A. D. Pool, J. L. McKinley, L. Makous.
Exhibiting: Single phase and polyphase electric motors.

SPENCER THERMOSTAT CO., 34 Forest St., Attleboro, Mass.—Booth 1008.

SPORLAN VALVE CO., 7525 Sussex Ave., St. Louis 17, Mo.—Booths 219 and 221.
In attendance: H. T. Lange, H. F. Spoehrer, W. T. Carmody, W. F. Wischmeyer, W. L. Canfield, H. F. Shield, M. D. McAnany, C. C. Grote, W. A. Reichenbach, A. L. Javes, T. H. Silary, J. E. Dannels, J. T. Barry, E. C. Fockler, P. J. McCarty.
Exhibiting: Thermostatic expansion valves, solenoid valves, solenoid pilot controls, refrigerant distributors, strainers. Featuring the "Catch-All" (filter-dehydrator in 1/3, ½ and 1 ton sizes); and solenoid pilot control in actual operation.

SUPERIOR VALVE & FITTINGS CO., 1509 W. Liberty Ave., Pittsburgh 26, Pa.—Booth 301.
In attendance: J. S. Forbes, I. A. Wilson, N. M. Dunning, K. W. Rose, J. P. Bowen, A. L. Cody, R. C. Robertson, F. N. Robson, W. A. Siegfried.
Exhibiting: Valves, fittings, heat exchangers, driers, check valves, sight glasses, manifolds, charging hose, quick couplers, etc., and featuring new driers and sight glasses.

TECUMSEH PRODUCTS CO., Tecumseh, Mich.—Booth 708.
In attendance: C. M. Brown, F. K. Smith, J. K. Touborg, L. W. Larsen, F. G. Purcell, G. I. Boone, G. B. Boone, M. A. Shantz, J. E. Parker, R. T. Smith, J. E. Smith, J. W. Beneke, H. F. Moon, J. A. McLaren, W. H. Cody, A. L. Cody, V. A. Wilkinson, A. E. Boyea, F. A. M. Dawson, W. S. McLoud, W. C. McLoud.
Exhibiting: Hermetic and conventional compressors and condensing units. Display will feature two operating models and one hermetic cutaway in slow motion.

TEMPRITE PRODUCTS CORP., 47 Piquette Ave., Detroit 2, Mich.—Booth 509.
In attendance: L. Emde, P. Fred Lesley, O. F. Nelson, James J. Goodwin, James W. Archibald, H. B. Weeks, Austin L. Brown, J. S. Cortines, R. L. Williams, I. H. Cohler, J. D. Merkle.
Exhibiting: Equalizer, tanks, oil separators, adaptor blocks, two temperature valves.

TENNEY ENGINEERING, INC., 26 Avenue B, Newark 5, N. J.—Booth 423.
In attendance: Cleve A. Sewell, Monroe Seligman, Saul S. Schiffman, Sidney Shapiro, William Collins.
Exhibiting: Thermostatic expansion valve, unit cooler, all purpose cold air diffuser, automatic "Defrostulator," air conditioning coil, featuring new thermostatic expansion valve.

TORRINGTON MFG. CO., 70 Franklin St., Torrington, Conn.—Booth 1108.
In attendance: Donald G. Leslie, Roger T. Lyman, William E. Morrison, Fairfax R. Wheelan, Anthony N. Casadei.
Exhibiting: "Airistocrat" propeller type fan blades and "Airotor" blower wheels, and featuring new "M" fan.

TUBE MANIFOLD CORP., 1100 Military Rd., Buffalo, N. Y.—Booth 1018.

TYPHOON AIR CONDITIONING CO., INC., DIV. OF ICE AIR CONDITIONING CO., INC., 794 Union St., Brooklyn 15, N. Y.—Booth 907.
Exhibiting: Self-contained air conditioning units, and featuring technical developments and "Cool Profits in Air Conditioning."

UNITED CORK COMPANIES, Central Ave., Kearny, N. J.—Booth 316.
In attendance: Carl E. Schoeneman, Edward H. Bartsch, Frank Zimmerman, Edwin J. Ward.
Exhibiting: Corkboard insulation, cork pipe covering, "Sealtite" mastic, composition cork sheets.

VIRGINIA SMELTING CO., West Norfolk, Va.—Booths 204-206.
In attendance: A. K. Scribner, R. H. Israel, H. T. Palmer, H. B. Channon, J. R. Eldridge, F. W. Binns, W. C. Dever, W. B. Arbuckle, E. V. Dunbar.
Exhibiting: Refrigerants, and featuring a special entertainment surprise for visitors.

WABASH MFG. CO., 2642 S. Michigan Ave., Chicago 16, Ill.—Booth 302.
In attendance: E. W. Mack, M. T. Cahenzli, R. E. Caplan.
Exhibiting: Driers, strainers, capillary tubes, speed couplers, capillary tube heat exchangers, charging hoses, oil separators, high side floats.

WAGNER ELECTRIC CORP., 6400 Plymouth Ave., St. Louis 14, Mo.—Booth 1118.

WEATHERHEAD CO., 300 E. 131st St., Cleveland 8, Ohio.—Booth 119.
In attendance: Booth will be in charge of James A. Strachan.
Exhibiting: Improved valves, fittings, driers, and accessories.

WESTINGHOUSE ELECTRIC CORP., 653 Page Blvd., Springfield 2, Mass.—Booth 419.

WHITE-RODGERS ELECTRIC CO., 1209 Cass Ave., St. Louis 6, Mo.—Booths 211-213.
In attendance: L. F. Blough, Ed. C. Robinson, Jack Searls, Chas. Taber, E. E. Harwood, Ray Schmitz, Chas. O'Brien, D. O. Eggert.
Exhibiting: Complete line of refrigeration pressure and temperature controls, including the automatic defrost control. The temperature controls are operated by the "Hydraulic-Action" principle, known for "exceptional accuracy and dependability."

WOLVERINE TUBE DIV. of Calumet & Hecla Consolidated Copper Co., 1411 Central Ave., Detroit 9, Mich.—Booth 505.
In attendance: W. H. Maxwell, A. S. Kingerley, A. R. Kaspark, J. A. Marshall, W. P. Hill, H. A. Harty.
Exhibiting: Seamless nonferrous tube; fabricated tubular parts; "Trufin" integral finned tube. Improved end connections between "Trufin" and commercial plain tubes will be featured.

YORK CORP., York, Pa.—Booths 420-422.
In attendance: D. C. Seitz, W. E. Landmesser, J. R. Hertzler, J. Donald Smith, H. L. Hupp, B. C. Reeder, W. H. West, M. J. Lash, C. J. Schurman, H. S. Yoder, M. S. Lebair, C. C. Strauch, Leon E. Kinley.

KINETIC CHEMICALS, INC., 10th & Market Sts., Wilmington 98, Dela.—Booth 216.

In attendance: R. J. Thompson, R. L. Williams.
Exhibiting: "Freon" refrigerants.

KRAMER TRENTON CO., North Olden & Breunig Aves., Trenton 5, N. J.—Booths 116 and 118.

In attendance: S. Charles Segal, Harry Klingler, Israel Kramer, Nathan Kramer, Frank C. Obert.
Exhibiting: New coil designs; new design and application of fractional horsepower fan duty type evaporators; extra large ceiling type evaporators; "major innovation" of the radial unit cooler, details to be announced at the show; working model of "Thermobank," illustrating the automatic defrost for low temperatures; new design of air cooled condenser.

LARKIN COILS, 519 Memorial Drive, S.E., Atlanta 1, Ga.—Booths 710 and 712.

In attendance; O. M. Sims, S. D. Hughes, C. L. White, J. E. Palmer, E. A. Gustafson.
Exhibiting: Fin coils, blower units, air conditioning units, evaporative condensers, floor model blower unit, heat exchangers, bare tube coil.

LEWIN-MATHES CO., 1111 Chouteau Ave., St. Louis 2, Mo.—Booth 1022.

In attendance: Alan "Bud" Lewin, Larry Powell.
Exhibiting: Refrigeration copper tube.

LIBERTY MOTORS & ENGINEERING CORP., Coolidge & Constance Aves., Arbutus, Baltimore 29, Md.—Booth 1207.

In attendance: H. A. Loebel, Anthony Easton.
Exhibiting: Packaged "systematized" refrigeration, featuring hermetic compressors and condensing units in ¼ and 1/3 hp sizes.

LINDE AIR PRODUCTS CO., 30 E. 42nd St., New York 17, N. Y.—Booth 1114.

LYNCH MFG. CORP.—3600 Summit St., Toledo 1, Ohio.—Booths 201 and 102.

In attendance: M. H. Pendergast, J. P. McCarthy, F. K. Zimmerman, R. L. Sears, A. V. Petersen, R. R. Seibel, G. C. Davis, Wm. Gardiner, D. E. Stenson, B. J. Scholl, C. B. Pierce, B. D. Berk, E. W. Montgomery, W. A. Doepel.
Exhibiting: "Par" condensing units.

MARLO COIL CO., 6135 Manchester Ave., St. Louis 10, Mo.—Booths 404, 406, 408, 410.

In attendance: Wm. J. Bagley, A. T. Marlo, F. G. Meyer, C. D. Marlo, L. C. Pellegrini, W. B. Moses, Jr., R. C. Holsworth, Wm. C. McIntyre, H. R. Iverson, G. M. Sebree.
Exhibiting: Forced draft cooling towers, evaporative condensers, industrial type units, and unit coolers for high and low temperature applications.

MARSH CORP., JAS. P., Skokie, Ill.—Booth 114.

In attendance: Jim Emmett, Bob Burnett, Ed Kluger, Frank Zicarelli, A. C. DuPerow, Fred Hudson.
Exhibiting: Complete line of refrigeration gages and thermometers, including the "Serviceman." Also new "Duo-Temp" inside and outside thermometer.

MAYFLOWER PRODUCTS, INC., 13 S. 5th St., Richmond, Ind.—Booth 122.

In attendance: Al Green, B. D. Rinehart.
Exhibiting: 2 ton ceiling air conditioner; condensing units, ¼ hp up to 3 hp, both air and water cooled. New models, new finishes and colors and other improvements will be featured.

McCORD CORP., 2587 E. Grand Blvd., Detroit 11, Mich.—Booth 107.

In attendance: Morrill Dunn, F. W. McMillan, J. R. Hayward, E. O. Bodkin.
Exhibiting: Condensers, evaporators, fin tubing.

McINTIRE CONNECTOR CO., 263 Jefferson St., Newark 7, N. J.—Booth 611.

In attendance: L. S. Dunn, H. A. Chandler, J. G. Beierlein, George D. Metzger.
Exhibiting: Driers, filters, strainers, moisture indicator, special equipment for low temperature dehydration.

McQUAY, INC., 1600 Broadway St., N.E., Minneapolis 13, Minn.—Booth 602.

In attendance: R. J. Resch, E. H. Seelert, H. Blake Thomas, C. L. Bensen, R. N. Weber.
Exhibiting: Normal temperature and water defrost unit coolers, unit heaters, multilouver coils, round ceiling unit coolers. Featuring new wall-type unit cooler known as the "Panel Chillator."

MILLS INDUSTRIES, INC.—4100 Fullerton Ave., Chicago 39, Ill.—Booths 109 & 111.

In attendance: Harrison J. Hedrick, Hillis D. Iams, Carl L. Picker, Alexander T. Murray, Walter Babick.
Exhibiting: Condensing units, ¼ to 10 hp inclusive.

MINNEAPOLIS-HONEYWELL REGULATOR CO., 2604 Fourth Ave., S., Minneapolis 8, Minn.—Booth 701.

In attendance: W. H. Kramer, W. P. Mader, Richard Hanschen, G. M. Kingsland.

MITCHELL MFG. CO., 2525 Clybourn Ave., Chicago, Ill.—Booth 1017.

In attendance: B. A. Mitchell, E. A. Nickel, John Jennings, E. Geishert, Fred Masterson, C. Schroeder, Paul Smith.
Exhibiting: Room type and window type units.

MUELLER BRASS CO., 1925 Lapeer Ave., Port Huron, Mich.—Booths 307 and 309.

In attendance: Fred Riggin, Jr., L. Parker, John Gray, P. L. Craft, M. R. Pritchard, C. Schumann, E. F. Hall, P. O. Domke.
Exhibiting: copper tube; complete line of valves, fittings, and accessories for mechanical refrigeration, including testing manifolds, filters and strainers, driers, heat exchangers, liquid indicators, service tools; the "Little Giant" purger; featuring the recently introduced "Midget" purger for smaller systems; "Streamline" solder type fittings.

NATIONAL ASSOCIATION OF REFRIGERATION CONTRACTORS, 353 Hippodrome Annex, Cleveland 15, Ohio.—Booth 1218.

Exhibiting: Educational exhibit depicting services rendered by the association.

NEVINGER MFG. CO., INC., Greenville, Ill.—Booth 913.

OWENS-CORNING FIBERGLAS CORP., Nicholas Bldg., Toledo, Ohio.—Booth 1005.

In attendance: C. L. Rowley, J. R. McCord, E. W. Darling, Jr., Paul E. Benner, Roy Hunsaker, John Dowd.
Exhibiting: Thermal insulation, "Dust Stop" air filters.

PACIFIC LUMBER CO., 100 Bush St., San Francisco, Calif.—Booth 1208.

In attendance: Edric E. Brown, John H. Klass, Ray P. Klass, Stanley H. Dickson.
Exhibiting: "Palco Wool" insulation.

PACIFIC MFG. CORP., 5308 Blanche Avenue, S.E., Cleveland 4, Ohio.—Booth 1109.

In attendance: S. C. May, J. H. Merritt, Jr., H. C. Troth, and others.
Exhibiting: Packaged air conditioners, featuring new models for 1948 line.

SHOW HOURS

MONDAY, JANUARY 26, 1948*
2 p.m. to 10 p.m. — Open to entire industry

TUESDAY, JANUARY 27, 1948**
12 Noon to 6 p.m.
Open only to refrigeration contractors, dealers, and service engineers

WEDNESDAY, JANUARY 28, 1948
12 Noon to 6 p.m. — Open to entire industry

THURSDAY, JANUARY 29, 1948
10 a.m. to 4 p.m. — Open to entire industry

***There will be a preview for wholesalers only on Monday, from 10 a. m. to 2 p. m.**
****Though contractors and service engineers have been invited to attend on all four days, Tuesday has been set aside for them exclusively.**

PEERLESS OF AMERICA, INC., 2901 W. Lawrence Ave., Chicago 25, Ill.—Booths 707 and 709.

In attendance: M. W. Knight, W. A. Honeychurch, J. M. O'Connor, Carl Johnson, David Snow, George Francis, Roy Stuhlman, H. B. Weeks, R. L. Williams.

Exhibiting: Fin coils, flash coolers, capacity boosters, expansion valves, unit coolers, product coolers, evaporative condensers, air conditioning coils, water coils, steam coils. Featuring new air conditioning units and evaporative condensers.

PENN BRASS & COPPER CO., 20th & Powell Ave., Erie, Pa.—Booth 613.

Exhibiting: Seamless brass and copper tubing; "Papco" flaring tool; cut-off tool.

PENN ELECTRIC SWITCH CO., Goshen, Ind.—Booth 1011.

In attendance: M. E. Henning, R. H. Luscombe, K. W. Cash, B. J. Gill, C. B. Morgan, J. R. Netedu, D. G. Cameron, F. W. Hottenroth, N. E. Jennison, A. W. Barr, A. L. Rubel, R. V. Clark, W. W. Lige, L. Linehan, G. O. Sanders, O. G. Tinkey, J. Moravec, J. P. Bowen, H. D. Gray, E. M. Smith.

Exhibiting: Series "270" pressure and temperature controls (of load carrying two-pole construction), cooling room thermostats, humidistats, water regulating valves, solenoid valves.

PHILLIPS & CO., H. A., 3255 W. Carroll Ave., Chicago 24, Ill.—Booth 912.

In attendance: Grant Phillips, William Richards, Robert Bailey, Rush Langdon, George Noll.

Exhibiting: Recirculating injectors for refrigerants, valves for ammonia and "Freon," ammonia liquid line filters, precision type pressure gages in sizes from 3½ to 6 in. dial.

RANCO INC., 601 W. Fifth Ave., Columbus 1, Ohio.—Booths 310 & 312.

In attendance: G. E. Graff, W. H. Stanley, A. J. Meyer, C. M. Spielman, R. G. Raney, M. S. Vidis, A. C. Homeyer, H. M. Laird, C. E. Whipps, J. D. Merkle, C. E. Boren, F. G. Slagel, E. V. Dunbar, H. M. Goldberg.

Exhibiting: Refrigeration controls. New products to be shown will be power elements of beryllium copper.

REDMOND CO., INC., Owosso, Mich.—Booth 1211.

In attendance: R. T. Abrell, James Tweedy, W. R. Fox, L. G. Andrian.

Exhibiting: Low range fractional horsepower electric motors in sizes up to 1/15 hp, small blowers and speed controllers. Featured will be a new 1/15 hp motor with die cast frame, built in sizes up to 1/20 hp in totally enclosed models; new 1/15 hp open ventilated motor with drawn steel case; improved motors in sizes up to 1/25 hp with die cast frames.

REFRIGERATION APPLIANCES INC., 917-923 W. Lake St., Chicago 7, Ill.—Booth 1015.

In attendance: E. Niederer, J. Eichhorn, F. A. Klaas, W. A. List, Hugh D. Smart.

Exhibiting: Complete line of 1948 design low side commercial refrigeration equipment including "Freez-E-Fex" electric defrost, "Strat-E-Fex" ceiling unit, "Flo-E-Fex" wall unit, "Blo-E-Fex" floor type unit.

REFRIGERATION ENGINEERING INC., 7250 E. Slauson Ave., Los Angeles 22, Calif.—Booth 714 A.

In attendance: Hy Jarvis, W. F. Hancock, Dan D. Wile, Sterling F. Smith.

Exhibiting: New "Recold" evaporative condensers, water defrost evaporators, "Supreme" coil, "Tiny Mite Suctionair" coil.

REFRIGERATION EQUIPMENT WHOLESALERS ASSOCIATION, 920 E. McMillan St., Cincinnati 6, Ohio.—Booth 1206.

In attendance: The board of directors of the association at different intervals and H. S. McCloud, executive secretary, and Katherine S. Fisher, assistant secretary.

REFRIGERATION SERVICE ENGINEERS SOCIETY, 433 N. Waller Ave., Chicago 44, Ill.—Booth 1214.

Exhibiting: Services provided membership of this association.

REMCO, INC., Zelienople, Pa.—Booth 425.

In attendance: Kenneth M. Newcum, Walter P. Stewart, Wallace A. Henry, Hugo C. Smith, Charles W. Wilmes, Arthur K. Johnston, Thomas E. Scott, R. A. (Burt) Paton.

Exhibiting: Driers, drier-filters, filters, heat exchangers. Featuring an operating refrigeration system with new heavy duty "Cross-Flo" drier-filter arranged in the system with gages and thermometers to show effect of pressure drop through driers, and to show the effect of refrigerant temperature on drier performance.

ROTARY SEAL CO., 2020 N. Larrabee St., Chicago 14, Ill.—Booth 207.

Exhibiting: Rotary seal replacement units as sold through refrigeration parts jobbers to the refrigeration service trade.

SCHNACKE, INC., 1016 E. Columbia St., Evansville 7, Ind.—Booth 123.

In attendance: F. C. Schnacke, E. J. Miller, T. G. Thomas, Basil S. Miller, Parke Syers.

Exhibiting: 5, 25, and 50 hp condensing units; cutaway section of a compressor. A "simple and vivid" display of one of the advanced refrigeration features incorporated in their product, the refrigerant-cooled cylinder sleeve, will be featured.

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Card No. 42
Job No. ___

___ FLOW CONTROL VALVES: Furnish and install in conjunction with the each circulating pump circuit a flow control valve of the size as shown on the plans. The valves shall be of an approved make.

Card No. 43
Job No. ___

___ SOLENOID VALVES: The solenoid and magnet valves shall be located where shown on the plans and preceding each valve shall be placed a strainer and a valve. These valves shall be designed for ____ 125 psig working pressure.

Card No. 44
Job No. ___

___ THERMAL EXPANSION VALVES: Expansion valves of the approved type with external equalizing line and an externally internally located remote bulb shall be installed to serve cooling coils in the units. The valves shall be designed to operate at 12 F ___ superheat using "Freon 12" _____ as the refrigerant.

Card No. 45
Job No. ___

___ BALANCING FITTINGS: Furnish and install in the return pipe from each radiator and convector and unit heater a balancing elbow or balancing straightway fitting. These fittings shall have nickel finish with bright nickel trim the same finish as the radiator valves designed for 125 psi water pressure of the size of the respective pipes for the purpose of balancing the hot water heating system and shall be similar to _________

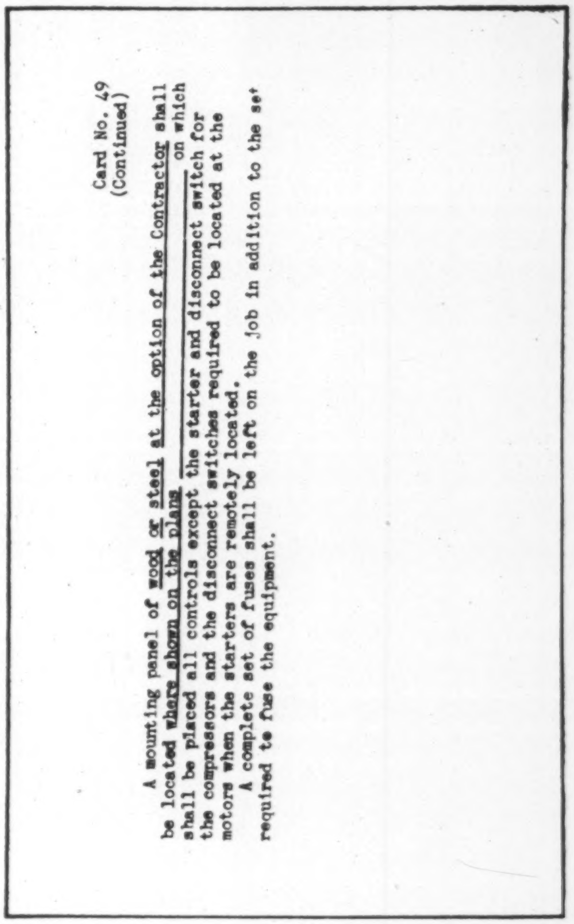
____

DATA SHEET

Simplified Procedure for SPECIFICATION WRITING

Due to a number of requests from readers for more information about the method described in George W. Campbell's article, A Simplified Procedure for Specification Writing, which was published in the April 1946 issue of HPAC, it was decided to run as a supplement to this article a series of specification cards which are used by the firm of Urdahl and Everetts, consulting engineers, in their Washington, D. C., and San Francisco offices. Mr. Campbell is employed in the Washington office.

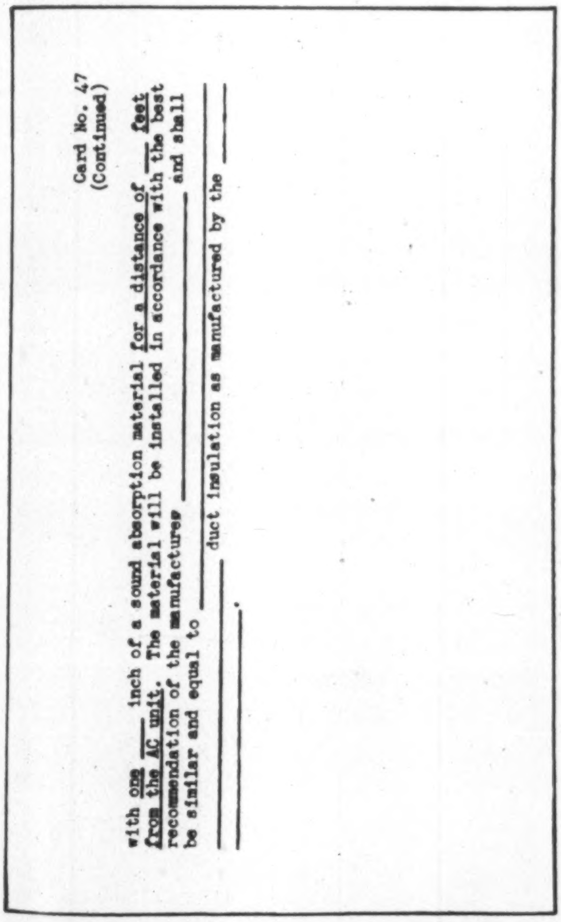
Several of the cards have been published (and details of their use explained) in the June-November issues inclusive, more appear this month, and others will follow. These specifications are not to be construed as recommendations to other consultants but to illustrate this card file used by Urdahl and Everetts.



Card No. 49
(Continued)

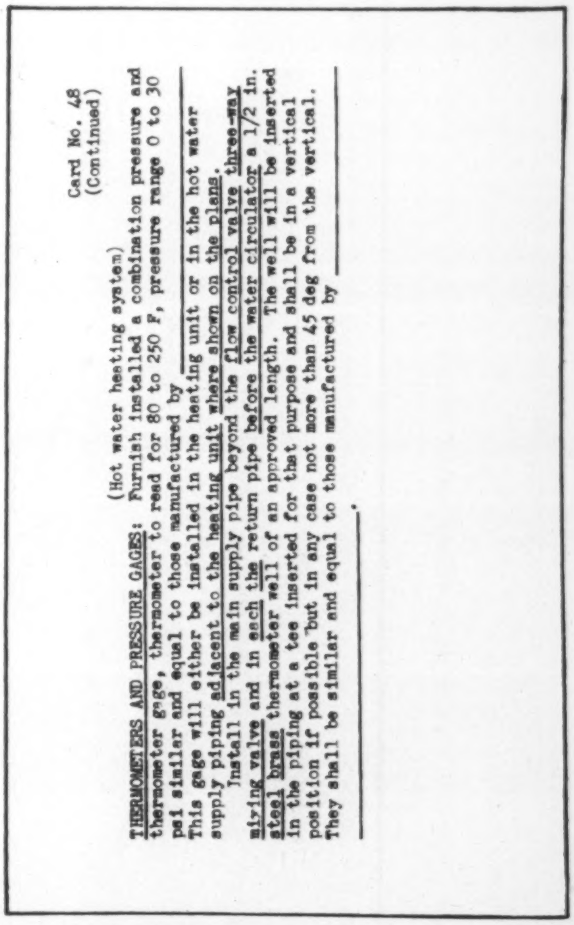
A mounting panel of wood or steel at the option of the Contractor shall be located where shown on the plans ____________ on which shall be placed all controls except the starter and disconnect switch for the compressors and the disconnect switches required to be located at the motors when the starters are remotely located.

A complete set of fuses shall be left on the job in addition to the set required to fuse the equipment.



Card No. 47
(Continued)

with one ___ inch of a sound absorption material for a distance of ___ feet from the AC unit. The material will be installed in accordance with the best recommendation of the manufacturer ____________ and shall be similar and equal to ____________ duct insulation as manufactured by the ____________ ____________.



Card No. 48
(Continued)

(Hot water heating system)

THERMOMETERS AND PRESSURE GAGES: Furnish installed a combination pressure and thermometer gage, thermometer to read for 80 to 250 F, pressure range 0 to 30 psi similar and equal to those manufactured by ____________. This gage will either be installed in the heating unit or in the hot water supply piping adjacent to the heating unit where shown on the plans.

Install in the main supply pipe beyond the flow control valve three-way mixing valve and in each the return pipe before the water circulator a 1/2 in. steel brass thermometer well of an approved length. The well will be inserted in the piping at a tee inserted for that purpose and shall be in a vertical position if possible but in any case not more than 45 deg from the vertical. They shall be similar and equal to those manufactured by ____________ ____________.

Card No. 48
Job No. ___

(AC System)

___ THERMOMETERS AND PRESSURE GAGES: Furnish and install a 7 in. scale mercury thermometer in cases of the easy-reading type in the return duct and discharge duct for each the air conditioning unit. Furnish and install ½ in. ID thermometer wells, in a vertical position if possible, and pressure gage cut-off valves for testing the system in the suction line and hot gas line adjacent to each the compressor, hot gas line and liquid line adjacent to each the evaporative condenser, and liquid line and suction line adjacent to each the air conditioning unit, and in the common suction line near the compressor.

In addition to these gage valves, a pressure gages shall be mounted on the control panel board taken from the suction line and hot gas line at each the compressor and from the common suction line.

The thermometers shall have a scale from 30 F to 180 F and shall be similar and equal to ____ _________ ___________________. The pressure gages are to have a scale suitable for the operating pressures and to be for "Freon 12" _____________ systems. The pressure gages shall have 4½ in. ___ faces suitable for mounting on the panelboard.

(over)

Card No. 49
Job No. ___

___ ELECTRICAL WORK: The electrical service will be ___ volts, 60 cycle, three _____ phase, _____ wire. The location of service meter equipment is shown on the plans.

The Contractor shall furnish and install all electrical wiring, suitable starters, relays, controls, disconnect switches, junction boxes, etc. from the meter disconnect switch for the satisfactory operation of the equipment as described under "CONTROLS". A ___ ampere disconnect switch will be furnished by this contractor ______________________ at the point of entrance of the service to care for all of the equipment under this contract except ____.

All starters serving motors of __ hp and over shall be of the automatic type unless specified otherwise under "CONTROLS". All compressor starters shall be of the reduced voltage across the line _______________ type with overload and undervoltage protection to comply with the requirements of the local Electric Power Company, Board of Fire Underwriters, and ____________ _________________. The starting current will not exceed ___ amperes.

All starters operating remotely controlled equipment shall be equipped with pilot lights of an approved type which are lighted by current from the load side of the starter ____.

All motors shall be wound for ___ volt, 60 cycle, three and single phase current unless otherwise indicated for that particular equipment.

(over)

Card No. 47
Job No. ___

(steam and hot water)

___ INSULATION: Piping Insulation - Insulate all steam and hot water supply and return piping with standard thickness ___________________ _____ pipe insulation similar and equal to that which is manufactured by the ______________________________.

(refrigerant suction piping)

The refrigerant suction piping shall be insulated with ___ inches of standard ____________ thickness ______________________________ pipe insulation for OD pipe sizes with water proof jacket similar or equal to ______________________________ ______________________________ as manufactured by ______________________ ________________________ ________________. The insulation on the refrigerant suction piping shall not be pierced by the hangers.

Duct Insulation: All supply and return ducts and plenums in the unconditioned spaces shall be insulated with one ___ inch of semi-rigid ________________ insulation similar and equal to __________ ____________________________________ insulation as manufactured by the ___________________ ______________________________. The return ducts shall be insulated with one inch of insulation of the type specified under supply ducts.

Sound Absorption: The supply duct plenum shall be lined with one ___ inch of a sound absorption material for a distance of ___ ten feet from the fan discharge. The return ducts and plenum shall also be lined

(over)

Card No. 46
Job No. ___

(plumbing)

___ VALVES: a. All plumbing and cold water valves from 2 in. and smaller shall be of the non-rising stem, gate valve type with brass bodies and polished fittings to be used with threaded soldered pipe, and all plumbing and cold water valves above 2 in. shall be of the non-rising stem, gate valve type with iron body and brass trimmings to be used with threaded soldered pipe to ___ in. dia. and flanged pipe above and including ___ in. dia.

(hot water heating system and steam piping)

b. All hot water and steam piping valves shall be of the gate type with brass body with polished trimmings. These valves shall be of the non-rising stem type designated for 125 ___ psig working pressure to be used with screwed pipe to ___ in. dia. and flanged pipe above ___ in. dia.

(radiator)

c. All radiator valves shall be of the steam pattern with rough brass nickel plated body with polished trimmings. These valves shall be of the angle or gate type.

(refrigeration)

d. All valves passing the refrigerant shall be designed for this service, having a brass body and trimmings, and shall be of the rising stem globe type. These valves shall be of the back-seat type with a stem cap. They shall be designed for operation at a working pressure of 200 psi and shall be able to withstand a total pressure of 300 psig. They shall be for soldered joints and shall be for tubing sizes.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Economic and Technical Aspects of the Heat Pump

By W. E. Johnson*, Bloomfield, N. J.

SUMMARY — Factors determining the practicability of the heat pump for industrial and residential use are chiefly economic. In industrial application the internal heat from lights and processes tends to increase the cooling requirements in summer and decrease the heating load in winter, thereby creating a condition favoring the use of the heat pump.

Introduction

Since the spotlight of publicity has been focused on the heat pump, many people believe that the technological advances of the war years will now make this development a practical product that many people can own. Actually, all the evidence indicates that the advent of the heat pump depends much more upon economic factors than upon technological advances.

This paper gives a brief discussion of the field of usefulness of the heat pump and a more detailed discussion of the technical and economic problems associated with its application to residential air conditioning.

Applications of the Heat Pump

Industrial Applications: Because of a plentiful supply of ordinary fuels in this country the heat pump has not been used in industry to the extent which is possible. In this respect U.S. practice may be contrasted very sharply with that of Switzerland where ordinary fuels are very scarce and water power is relatively abundant. In western and north western United States, where water power is plentiful and where coal is relatively expensive, it may well be that the heat pump will find increasing use in industrial processes.

One industrial process in which the heat pump can be applied is that involving the concentration of solutions. This includes the concentration of milk, fruit juices, the concentration of syrup in sugar refining and similar processes. There are three distinct methods by which such a process can be performed economically. The first of these and one that is commonly used at the present time is multistage evaporation. A four stage system, for example, will evaporate almost three pounds of steam for each pound of steam used. If fuel is inexpensive and if the investment charges are reasonable, this is obviously one of the most economical methods.

Another method of concentration is one in which direct compression of the vapor is used. By increasing the pressure of the vapor the necessary temperature differential between the distillate and the solution is obtained. This method has been used in Switzerland successfully. It has the advantage of eliminating temperature drops between the fluids and the heat transfer surfaces that are required with an indirect compression system. This system is shown schematically in Fig. 1.

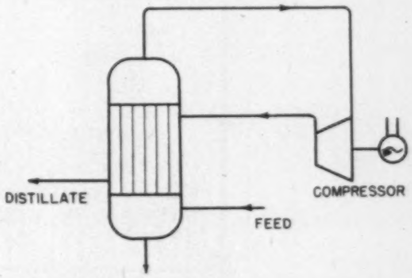


Fig. 1—Distillation by direct compression

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*Manager of Engineering, Air Conditioning Dept., General Electric Co.

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A third method, the indirect compression system, illustrated in Fig. 2, makes use of separate heat transfer surfaces and a separate thermodynamic fluid in a closed cycle. As mentioned, it has the disadvantage of requiring temperature differences between the distillate and the heat transfer surfaces in order to keep the size of the heat transfer surface within economical limits. On the other hand, it has the advantage of a closed cycle, with its freedom from corrosion and precipitation problems, and in most cases the density of the thermodynamic fluid is such that a physically smaller machine can be used than that required by the direct compression system.

Many of the dehydration processes such as those used in paper mills, fruit drying, seasoning of lumber, etc., can be most economically performed by the moderate use of heat together with a large movement of air. In particular cases, however, if a great deal of heat is being wasted it may be economical to pump this heat back into the system with a heat pump.

In this paper it is not the purpose to discuss industrial applications of the heat pump fully but merely to mention them as part of the background.

Commercial Applications: Commercial applications of the heat pump may be defined as applications to those businesses in which service to customers is performed more or less directly and in which the profit motive is the strongest in determining whether a heat pump should be applied. These include office buildings, theaters, restaurants, beauty parlors, hotels, department stores and other commercial establishments in which the comfort of customers and efficiency of employees are determining factors in the business.

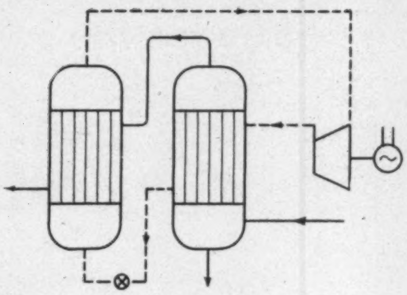

Fig. 2—Distillation by indirect compression

The most important technical difference between the commercial installation and a residential installation is that practically all commercial installations have a relatively much greater internal generation of heat than a residence. This heat comes from lights, heat given off by people, from cooking and from other sources. It reduces the requirement for heating in the winter and increases the requirement for cooling in the summer to such a degree that the economics of heat pump applications are completely different than those for residences. This is illustrated by a theater application shown in Figs. 3 and 4.

The place that the electric heat pump will take in this market is a matter of much speculation at the present time and it is doubtful whether anyone can predict with accuracy the course of this development for the next few years. However, it is certainly helpful to look clearly at all the problems involved so that the industry can at least chart its course for the immediate future. It is the principal purpose of this paper to discuss the problems of the heat pump when applied to residential air conditioning.

Technical—Economic Problems in Residential Air Conditioning

The Temperature of the Heat Source: There are two important kinds of heat source that must be clearly distinguished in any heat pump application. *First,* there is the heat source of variable temperature in which the temperature of the source decreases as the weather gets colder while at the same time the heat loss of the house is increasing. The second important classification is that in which the heat source is substantially constant or in which the temperature of the source will not suddenly fall below a satisfactory value.

The only common example of the first type is that in which outside air is used as the source of heat. Air as a source does not fall in the second class excepting in very temperate climates. The kind of heat source has a profound effect on the economics of design and this effect will be shown in more detail later. The major effect of a variable source such as air is substantially

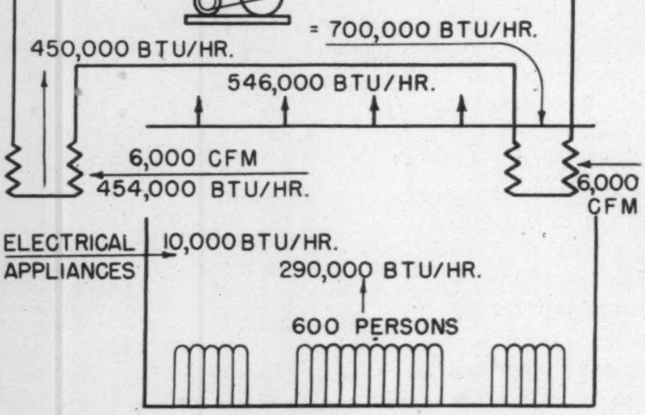

Fig. 3—Winter heat balance, ambient temp. 0 F (Park Theater, Caldwell, N.J.)

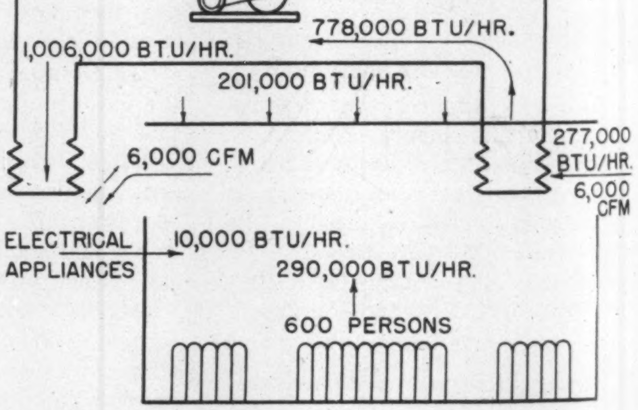

Fig. 4—Summer heat balance, ambient temp. 95 F (Park Theater, Caldwell, N.J.)

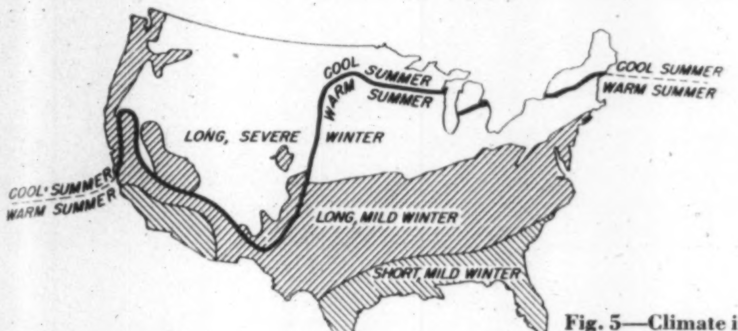

Fig. 5—Climate in the United States

to increase the maximum displacement rate required by the compressor whenever the design temperature goes below approximately 30 F. Design temperatures below 30 F are common throughout most of the United States. Some ideas of the geographical areas in which air-to-air residential heat pumps will be practical can be obtained from the map shown as Fig. 5.

A second major effect of the variable temperature heat source is to require a larger motor than would otherwise be required. It should be noted that the size of the heat transfer surface is not appreciably affected for any given heat loss. However, the extra displacement and the larger motor size together introduce some difficult problems in providing the automatic capacity modulation required, and they aggravate the problems of maximum electrical demand and the problem of starting without excessive currents.

Because of the inherent difficulties of using air as a source of heat, a great deal of emphasis has been placed recently upon the use of heat sources that fall in the second class (essentially constant temperature). Some of these are discussed in the following paragraphs.

The Use of Well Water: Well water when available makes an excellent source of heat since its temperature is usually close to the annual mean temperature and its temperature is not subject to sudden changes. The distribution of well water temperature over the United States is shown in Fig. 6. The sinking of a well and the provision of pumps must be considered, however, as a factor in first cost. Also to be considered is the problem of disposal. In some commercial installations this problem has been solved by drilling two wells, pumping from one and discharging into the other. This is entirely practicable as long as the wells are not too close together so that short circuiting can occur with a gradual decrease of temperature of the source. For residential heating, disposal by means of an extra well is probably not economical. Any extensive use of well water without restoration (pump back) would tend, in many localities, to deplete the supply and to give rise to local problems of disposal. Other problems arising in the use of well water which is pumped directly include the problem of corrosion and the maintenance of pumping equipment. The latter is not to be considered lightly when 24-hour service is a requirement.

For these reasons the use of directly pumped well water as a source of heat is not considered very practicable from the long range point of view for residential heat pumps, although it is entirely practicable in many commercial installations.

Underground Water—Not Pumped: If underground water is available, and particularly if it is moving, it is feasible to sink a heat exchanger into the ground in the form of a well through which a secondary medium is circulated to pick up heat from the water. This is the system used by one manufacturer. The heat exchange fluid may be water, or if conditions require, it might be a special solution.

The use of underground water in this manner, providing a source of heat at substantially constant temperature, has a profound influence on the design of the heat pump itself. The large displacement rate characteristic of a low temperature air-to-air system is no longer required and the motor can be sized more economically. The air side heat transfer surface with its air moving equipment is no longer required on the well side of the system and this naturally reduces the overall size. Against these advantages, however, must be charged the first cost of the well and the cost and maintenance of the fluid pumping element.

With this type of installation it is important that the presence of underground water be known in advance of installation. The chemistry of the water should be investigated in relation to the metals used, and it should be determined whether the underground water is moving or stationary. A very slow movement will, of course, make available great quantities of heat, but if the water is actually stationary there is some danger of freezing, and this might not be discovered until the most severe weather has caused the maximum demand to be placed on the well.

Earth as a Source of Heat: While the earth under some conditions is a practical source of heat, there are probably some misconceptions about its use. The heat that flows from the center of the earth and through its crust apparently comes through at an exceedingly slow rate. Dr. E. N. Kemler in his recent paper on *Properties of the Earth* gave an interesting tabulation showing the wide range of conductivities that have been reported for different kinds of earth under different conditions of moisture. These conductivities ranged all the way from 0.2 to over 2.0 Btu per (hr) (deg) (ft). If a conductivity of 0.5 is assumed, it would require several acres of ground to supply heat from the center of the earth at the rate required for a six or seven room house.

In practice, if the evaporator tubes are sunk into one or more trenches 3 to 6 ft below the surface, the amount of heat picked up from the center of the earth will be almost negligible.

When the earth is used as a source of heat the true source is the sun which provides radiation and warm convection currents to heat the surface. The flow of this heat, of course, has a tremendous time lag. Nevertheless, it is this source, or heat from underground water, which is used to replenish the

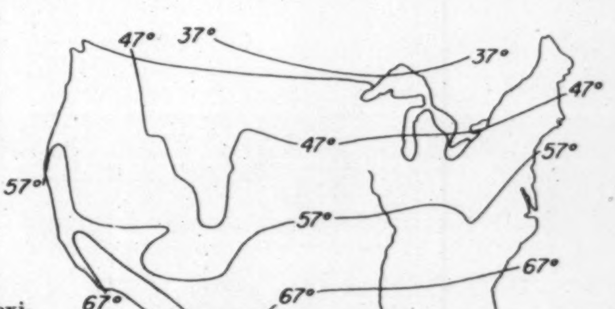

Fig. 6—Approximate well water temperatures at depths of 30 to 60 ft

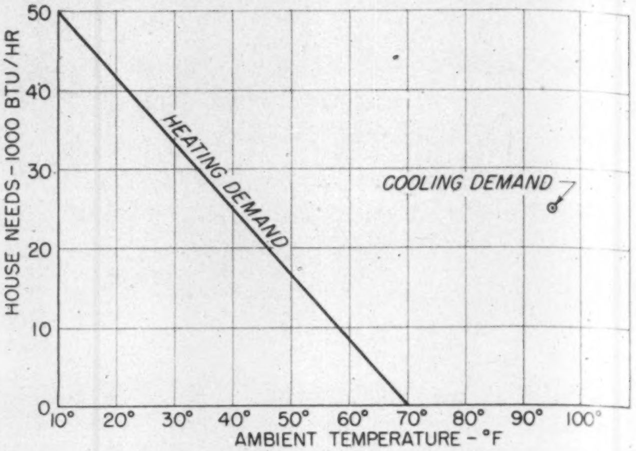

Fig. 8 — Heating and cooling demand for small house

heat drawn from the earth by a heat pump.

The Use of Water Storage: An air-to-air system making use of water storage for peak load conditions has been proposed many times in the past. While this system is workable it may have an economic disadvantage in that it combines most of the complexity of the air-to-air system with the additional first cost of a water storage system. Its chief advantage lies in reducing the size of the air-to-air heat pump required because it is capable of handling severe peaks of short duration.

Other Methods of Obtaining a Constant Temperature Source: Other methods of maintaining a reasonable temperature at the heat source have been proposed. One of these methods is the use of an air-to-air system with city water during peak load conditions. One of the difficulties of this system is that city water in many localities may get very low in temperature so that excessive quantities must be used. If the water is used as a spray on the outside air heat transfer surface, it tends to aggravate the defrosting problem.

Ice storage is another method that has been proposed and which can be used in much the same manner as water storage, since the ice in forming yields its latent heat. This system is beset with the well known problems of freezing ice, and allowing for its expansion.

Effect of Climate, Source of Heat, and Internal Heat Load on First Cost

This leads to the crux of the heat pump problem. This problem is one of determining the design that will give the most economical first cost considering the effect of climate, the nature of the source of heat and the influence of internal heat load in the building.

This problem has not yet been solved, and it is very probable that the best solution will not appear until a sufficient number of installations of different types of machines have been made to provide the answer. However, it is possible to gain some perspective of the problem by studying the cost trend of an air-to-air heat pump as a function of the winter design temperature. The results of an elementary study of this kind are shown in Fig. 7.

The cost figures shown in Fig. 7 are purely relative values taken from an arbitrary base of $500 per nominal horsepower at a 40 F winter design temperature. Fig. 7 is also based on the heating and cooling requirements of a small house that would require 50,000 Btu per hr of heating at a 10 F outdoor temperature.

The first significant point to note is that the cost of the machine is determined equally by the summer cooling and by the winter heating requirements down to an outdoor temperature of 40 F. Below this temperature the cost of the equipment is determined by the heating requirements because it must be larger than would be required by the summer cooling demand. This does not mean that the equipment is necessarily uneconomical at temperatures below 40 F when compared with a water-to-air system. Any comparison with a water-to-air system must take into consideration the first cost of the well and its auxiliary equipment.

The second and most important observation that may be made by referring to Fig. 7 is the very substantial effect of an internal heat load. If it is assumed that this same structure were used for commercial purposes and if in such use an internal load were generated sufficient to maintain a 15 F differential in the winter, and with ventilation excluded, it will be observed that the cooling requirements in the summer are substantially increased and that an economical balance on first cost can be reached when the unit is applied for heating at outdoor temperatures down to 12 F.

The actual effect of internal heat load varies widely among different commercial installations and the points of economical balance for the first cost may vary widely from those shown for a typical small house in Fig. 8. However, the effect of an internal heat load such as is commonly encountered in commercial installations is fundamental and will often be of sufficient magnitude to have a major effect on the economics of the first cost. A particular case which confirms this

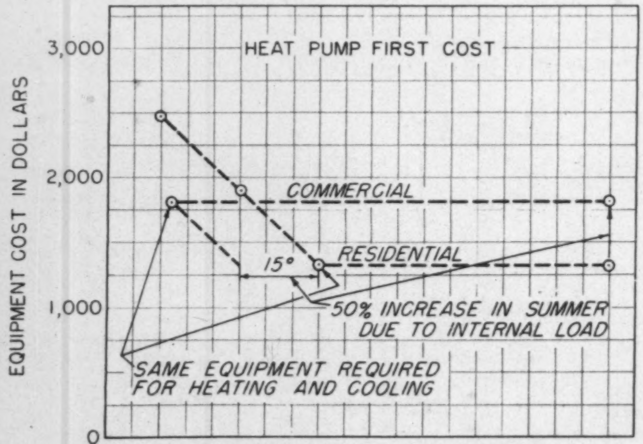

Fig. 7—Heat pump first cost

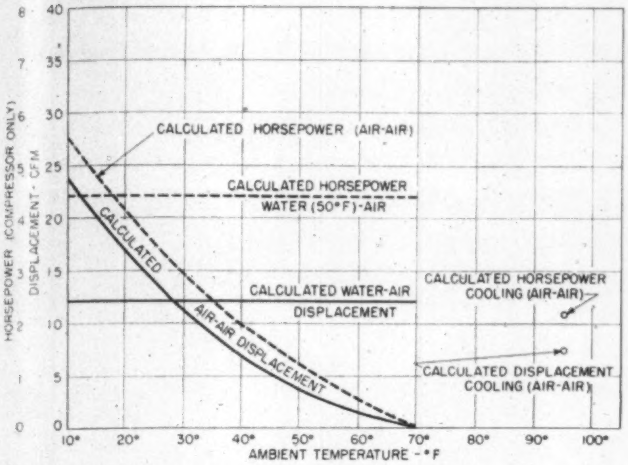

Fig. 9 — Relation of displacement rate and horsepower to design temperature

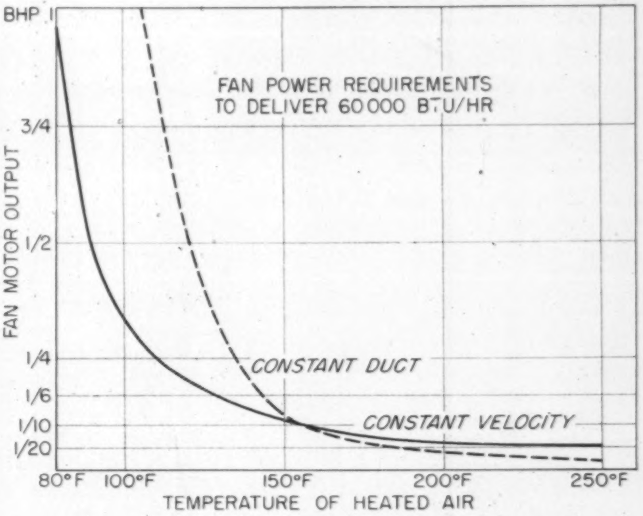

Fig. 10 — Fan power requirements to deliver 60,000 Btu per hour

conclusion was previously shown in Figs. 3 and 4 which illustrated a heat balance for a particular theater in which a very good balance was obtained for a 95 F summer design temperature and a zero F winter design temperature.

Before leaving this subject perhaps a word would be in order concerning the manner in which the cost trend shown in Fig. 7 was determined. The assumptions involved were these:

1. At the 40 F design point a cost to the user (less installation) of $500 per compressor horsepower was assumed. This figure is arbitrary and does not necessarily represent the true price of any particular unit. It is used only as a base point.

2. The total cost of the machine at the 40 F point was assumed to be divided equally among: (a) heat transfer surface; (b) motor compressor and its accessories; (c) structure, controls, and air moving equipment.

3. The costs of the foregoing three components were assumed to vary in the following manner.

(*a*) Since the physical size of the heat transfer surface is determined by the demand for heat, the cost of this component was assumed to vary in direct proportion to the heating demand at temperatures below 40 F.

The variations in heating demand are shown in Fig. 8.

(*b*) The cost of the motor compressor combination was assumed to vary as the first power of the required motor output. Ordinarily the cost of the motor compressor will not increase at so fast a rate with respect to its rating. In this case, however, the increase in displacement rate of the compressor and the complications introduced by requirements for capacity modulation at the lower outdoor temperatures would increase the cost at a rate faster than normal for this class of apparatus. Fig. 9 shows the manner in which displacement rate and compressor horsepower increase as the design temperature is decreased. It will be noted that the increase both in displacement rate and in motor power is very substantial.

(*c*) The cost of other elements was assumed constant.

On the basis of this approximation there is shown the very substantial difference in the economical winter design temperature for an air-to-air system that can be brought about by a moderate internal heat load such as may be encountered in a commercial installation.

The Problem of Delivering Low Grade Heat

One item that must be watched closely in the application of a heat pump is the cost of moving the air stream. Typically in a heat pump installation, the rate of air flow required to deliver heat to the house will be approximately twice that required in an ordinary automatic warm air conditioner such as an oil fired warm air unit. If the ducts are unchanged over those used with an ordinary heating system the power required for circulating the air will be excessive. Even when the ducts are designed for reasonably low velocity the power requirements will be higher than those of a more conventional warm air heating system. These relations are shown in Fig. 10.

Any substantial increase in power for moving air decreases the co-

Table 1—Fuel Costs for Heating—Northwest United States

Heat Source	Price	Btu Contained	Efficiency of Use Percent	Cost Per Million Btu	Annual Cost[a]	Equivalent Power Cost for Heat Pump
Bituminous Coal	$9.00/Ton	20,000,000/Ton	65	$0.69	$115	COP=3.5 $0.0082/kwhr
Oil	0.09/Gal	140,000/Gal	75	0.86	138	0.01/kwhr
Gas, Mfd.	0.60/Mcu ft	570/cu ft	75	1.40	234	0.017/kwhr

[a] Maximum demand = 85,000 Btu/hr; design temperature = +10 F; heating season = 4500 deg days.

Table 2—Fuel Costs for Heating—Northeast United States

Heat Source	Price	Btu Contained	Efficiency of Use Percent	Cost Per Million Btu	Annual Cost[a]	Equivalent Power Cost for Heat Pump
Anthracite Coal (Stoker)	$11.10/Ton	27,000,000/Ton	65	$0.63	$126	COP=3.5 0.0075/kwhr
Oil	0.087/Gal	140,000/Gal	75	0.83	166	0.001/kwhr
Gas, Natural	0.75-0.38/ Mcu ft	1,050/cu ft	75	0.95-0.48	190-96	0.011-0.006/kwhr
Gas, Mfd.	0.65/Mcu ft	550/cu ft	75	1.58	316	0.019/kwhr

[a] Maximum demand = 100,000 Btu/hr; design temperature = 0 F; heating season = 5400 deg days.

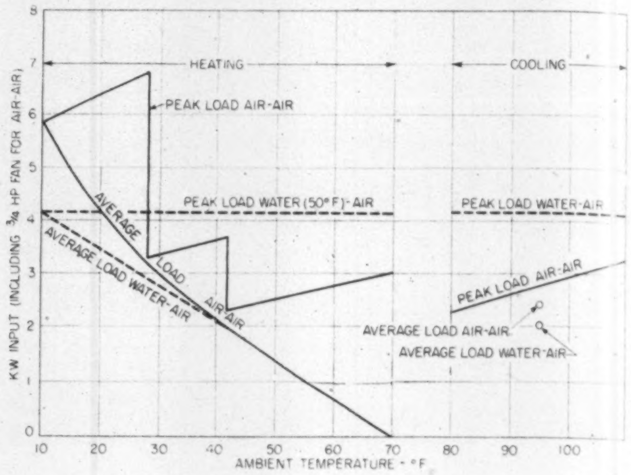

Fig. 11—Power requirements vs. air temperature

efficient of performance, and this problem is serious enough to make a heat pump unattractive unless the system is designed for low pressure drop.

Operating Economy

As a general statement it appears that in most localities and for moderate winter design temperature the heat pump can be competitive with other fuels on the basis of operating costs at a power rate of one cent or less per kilowatt hour. Tables 1 and 2 tabulate the competitive costs of electricity against some commonly quoted prices of other fuels.

It should be emphasized in this connection that overall seasonal weather conditions will have a great deal to do with the operating economy. A heat pump with a relatively low coefficient of performance at its design point may nevertheless compare favorably over an entire season if the design conditions are of short duration.

The cost of operating auxiliaries has already been mentioned in connection with the problem of delivering low grade heat, and the cost of operating blowers or water pumps will be found to be a significant item.

Another problem influencing the operating economy of the heat pump is the ratio of its peak load to its average load which may, in certain localities, impose unfavorable demand charges. These will, of course, vary with the locality and with the effect on the utility's distribution system. The use of a constant temperature source of heat such as well water is favorable from this point of view excepting in very temperate climates.

It will be noted in Fig. 11 that the maximum electrical demand will be substantially higher than the power required at the design point. This graph shows the results computed for an air-to-air design provided with capacity modulation in steps of 25 percent down to 25 percent of full compressor displacement.

It is difficult, at the present stage of the heat pump business, to give statistically averaged and authentic figures on actual operating costs. As a matter of interest, however, studies of two commercial and one residential installations gave power consumption rates ranging from 1/2 to 2/3 kwhr per degree day per installed compressor motor horsepower (installed power of auxiliaries not included).

Other Technical Problems

It has previously been emphasized that the important problems of the heat pump are primarily economic in nature. This does not mean that there are not a host of other problems that need attention and that will arise in any specific design. These other problems may all be considered minor to the extent that technical solutions are possible. For completeness some of these problems are mentioned in the following paragraphs:

Automatic Defrosting is a necessity on air-to-air systems. This has been a common problem in conditioned air coolers and there is no reason why it cannot be satisfactorily solved in the heat pump.

Automatic Capacity Modulation is a necessity on almost any design of heat pump and must cover a wider than normal range in an air-to-air system designed for low temperatures. A control problem in connection with this, arises from the fact that the response must reverse from summer to winter conditions.

Automatic Switching from heating to cooling and vice versa is at least a desirable feature and will probably be a necessity. In mild weather, particularly, people do not remember to move manual controls and as a result they suffer some discomfort.

Compressor Unloading and sequence starting of auxiliaries appears to be essential if single phase power is to be used and if starting currents are to be kept within acceptable values.

Automatic Reversal of Refrigerant Flow is one of the most attractive means of reversing the cycle from heating to cooling. With single coils, however, the system will tend to trap oil in one direction or the other and additional complications of the circuit are necessary to prevent this.

The Dissipation of Losses from Auxiliary Motors is an important one since it is desired to dissipate these losses into the house air in winter and into the outside air in summer.

Noise and Vibration are well-known problems, particularly in household appliances and equipment. The installation of equipment using several installed horsepower while maintaining noise levels in the order of 50 db is no easy task and is a different problem than that imposed by the usual commercial installation.

Serviceability is a vital requirement for any piece of equipment in the home on which the occupant is depending for his source of heat. Any heat pump that is designed for use in a home must be designed for rapid and efficient service so that operation can be resumed on short notice in case of failure.

Effect of Residential Heat Pump on Economics of Power Distribution

One of the most attractive features of the heat pump to the electric utility is its potential load building capacity. This is illustrated in Table 3 which shows an estimate (given by Philip Sporn[1]) of the annual electric power consumption in a typical home with and without a heat pump.

As mentioned previously, however, the heat pump itself may have unfavorable demand characteristics under certain circumstances. Moreover, during the early stages while

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[1] President, American Gas and Electric Service Corp., New York, N. Y.

Table 3—Energy Consumption—Kwhr Per Year

Class of Electrical Appliance	Without Heat Pump	With Heat Pump
Lighting, Misc. Appliances	346	346
Refrigerator	312	312
Radio	80	80
Flat Iron	64	64
Washing Machine	24	24
Vacuum Cleaner	20	20
Toaster	15	15
Electric Clock	14	14
Roaster	225	225
Ironing Machine	100	100
Percolator	72	72
Space Heater	45	45
Water Heating	2,625	1,308
Range	975	975
House Heating	0	8,900
House Cooling	0	2,000
Total	4,917	14,500

this type of load is developing, the effect on an electric distribution system is apt to be spotty and economically unfavorable until this type of load builds up. Table 2 shows the kilowatt demand plotted against outside temperature for a single unit. The increasing demand for a group of heat pumps in a small area will, of course, have better demand characteristics.

Another problem connected with the economics of power distribution is that of the seasonal load. In many areas heat pump installations will improve seasonal load characteristics. There are some areas, of course, where this may not be true, such as in the Gulf States where summer air conditioning may absorb the greatest load.

The common lack of three phase power in the suburban areas of cities is a vexing problem both to the manufacturer and to the user who must pay for the higher cost single phase motor and starting equipment. There appears to be no immediate change in prospect so far as the distribution of three phase power is concerned because of the greater investment outlay that would be required by the utilities. Consequently, heat pumps for residential service must for some time to come be designed for single phase power supply.

In many areas the advent of heat pumps will require the strengthening of secondary distribution and the addition of higher capacity transformers. It is presumed that the electrical utilities will be willing to make the necessary investment for strengthening the distribution system if it appears that the heat pump will offer a profitable load.

Marketing and Service Problems

Advantages of the Heat Pump to the Home Owner: Among the actual and potential advantages that a heat pump offers to the home owner may be mentioned the following:

1. A heat pump will furnish heat that will be clean and free from odor excepting such odors as may be acquired on wet surfaces during summer air conditioning.

2. If desired the chimney can be eliminated, thus saving a substantial item of construction cost.

3. For those who are willing to break with precedent, fixed double glazed windows can be used giving the immediate advantage of storm windows and eliminating the cost of the sliding sashes.

4. Properly applied to avoid drafts, low grade heat will probably give greater comfort and less sensation of heat and cold than the higher grade heat normally supplied by conventional heating systems.

5. A single piece of equipment provides the air conditioning for both summer and winter and this brings with it the advantage of dealing with a single service organization.

6. A single utility is used, saving the nuisance of additional fuel bills, and there is no fuel delivery problem.

7. There are no waste products to dispose of.

8. The heat pump will deliver heat quickly since it does not involve the time lag necessary for warming up a boiler or furnace.

Most of these advantages to the ultimate user are real. They will be appreciated and can be sold. However, it must be realized that the service which the heat pump offers is a service that can be obtained efficiently by other means now available. It does not at the present time compare as the automobile does to the horse and buggy. Consequently, it is doubtful that a substantial residential market will develop unless heat pump prices are reasonably competitive with other available means of providing year 'round air conditioning.

Influence of the Housing Situation: There are factors in the present housing situation which will tend to retard the use of heat pumps in home heating.

As mentioned previously the delivery of low grade heat requires a different design of duct system than that commonly used in present construction. As a consequence the installation of a heat pump in existing construction will tend to be expensive.

The basic economics of the heat pump indicate that its use in the home will almost certainly be limited to those installations in which the home owner desires summer air conditioning. A person in this financial class, if he already owns his home, will in many cases have it equipped with automatic heating and there may be little incentive for him to replace his existing system, particularly if it is relatively new.

Another factor in the housing situation is that a large percentage of present housing construction is being initiated by contractors for resale, the so-called speculative building. It is developing so much pressure on the price of homes that there is almost certain to be a corresponding pressure to reduce the percentage of cost represented by the heating plant. It is therefore unlikely that a speculative builder will install a new, relatively untried, and more expensive system except in the few cases where a prospective owner might specifically authorize it.

One factor in the housing situation which is favorable to the heat pump is the current interest in panel heating. This makes use of low temperature heat and thus tends to become a natural partner of the heat pump. Unfortunately, panel heating cannot be easily used for summer cooling, but there are ways of accomplishing the summer cooling while retaining the advantage of panel heating for the winter operation.

In general, it seems fair to state that the immediate housing situation with its emphasis on low cost housing is not favorable to the use of the residential heat pump. Over the next few years, of course, this situation will improve as individuals are able to build the kind of houses they want at reasonable prices.

The Need for Building a Service Industry: If heat pumps are to be sold for home use, it will be necessary that an efficient service industry be available. Moreover, during the initial period, while acceptance of the heat pump is growing it will be necessary to provide such service for thinly distributed installations. This problem would place a severe economic drain on any company that tried to extend its sales beyond its normal service area unless satisfactory arrangements could be made with independent refrigeration or air conditioning service establishments.

Conclusions

It is with some hesitancy that any conclusions are drawn on a subject as complex and dynamic as this one; nevertheless, conclusions there should be if we are to make the kind of progress that should be made in the next few years. It is recognized that these conclusions are necessarily of short range for the simple reason that many of the problems of the heat pump have not yet been actually solved and their solution will almost certainly bring some changes in the general outlook. In addition there are the uncertainties of our general economic situation and these too may drastically change any picture that is drawn today. With these reservations, the following are the conclusions that seem to follow most naturally from this study:

1. The operating cost of the heat pump will ordinarily be competitive with that of other fuels in areas of low power cost.

2. The use of heat pumps in industrial processes will depend on the economics of each individual process and upon the economics of the region in which the plant is located. There is probably a good potential market in this field, although in this country it will be limited by the relative abundance of natural fuels.

3. The fundamental economic problem of the heat pump, as applied to a residence, is that of its first cost which is related to such technical problems as the selection of the source of heat. It is emphasized that this problem has not yet been solved and probably will not be solved until competitive designs of several types have been applied over a sufficient area to determine the economics involved. It is very likely that both types of units (air source and water source) will find their own best markets.

4. For year 'round air conditioning in the home the most favorable market for the heat pump will be found:

   (a) In those geographical areas where the design heating requirement most nearly equals the design cooling requirement.

   (b) In those cases where the home owner desires and is willing and capable of paying for summer air conditioning. This places the market in the field of higher priced homes.

   (c) In those cases where new construction is being made by the home owners themselves. In existing construction the cost of replacing existing equipment will tend to discourage the use of the heat pump.

5. There are fundamental and significant differences relating directly to the economy of first cost that differentiate the commercial installation from the residential installation. In general these differences strongly favor commercial installations for the application of heat pumps, and because of this it is believed that the commercial market will develop most rapidly and will tend to pave the way for use of the heat pump in residential heating.

G. E. ANNOUNCES APPOINTMENTS

In announcing six new appointments which have been made in the commercial organization of General Electric's refrigeration machine and remote equipment divisions, W. F. R. Karsten, sales manager, stated that J. L. Roth has been placed in charge of commercial activities at the Ft. Wayne, Ind., plant. Other appointments include: W. G. Cox, sales manager; W. F. Benoit, sales manager, manufacturer sales; and R. M. Bukaty, H. R. Walker, and Milton Kalish, product specialists.

J. L. Roth

Mr. Roth, who graduated from New York University in 1929 with a mechanical engineering degree, has been connected with General Electric since 1930. After the entry of the United States in the Second World War, he was selected by the U. S. Engineers Corp to supervise and educate army personnel in the Caribbean district in the installation and maintenance of refrigeration and air conditioning equipment. In 1943 he returned to General Electric, serving their Bloomfield office as field engineer, later becoming district representative for the Chicago area.

A member of the ASHVE since 1946, Mr. Roth also holds membership in the *U. S. Military Engineers Society* and the F. & A. Masons.

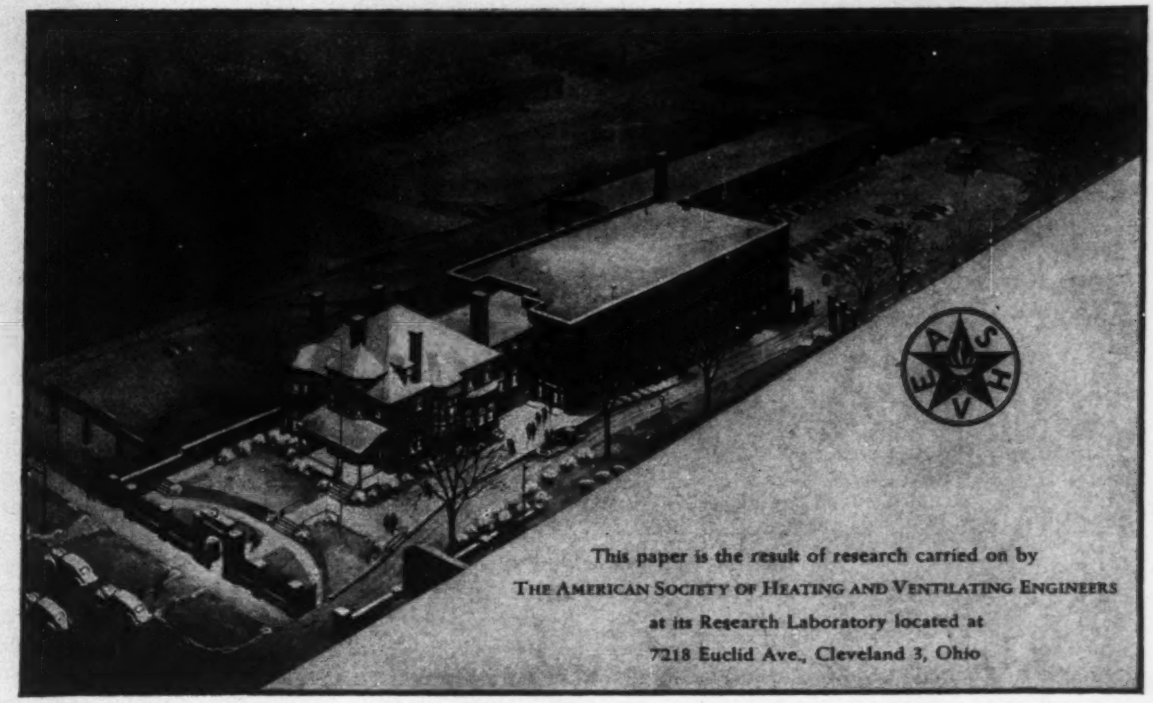
VANDERWEIL JOINS SLOCUM AND FULLER

R. G. Vanderweil has become associated with Slocum and Fuller, consulting engineers, 21 East 40 St., New York, N. Y.

For the past few years, Mr. Vanderweil had been connected with the Chase Brass & Copper Co., where, as project engineer, he handled the development work in connection with this company's radiant heating research program. During his early years with this company, he was concerned with heat transfer work and later developed a design method for radiant heating based on panel and heating tests. Previous to his employment with Chase Brass & Copper Co., Mr. Vanderweil was active as a heating and power plant engineer with the Austin Co., Combustion Engineering Corp., and Baker Smith & Co., in New York, N. Y.

Mr. Vanderweil who holds a master's degree in mechanical engineering from the University of Vienna, spent the first seven years of his practical experience in Austria. He is a member of the ASHVE and *ASME,* and holds a professional engineer's license in the State of Connecticut.

Members of the ASHVE are familiar with his work through the papers he has given on the subject of radiant heating.



This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

Friction Equivalents for Round, Square and Rectangular Ducts

By R. G. Huebscher*, Cleveland, Ohio

SUMMARY — Air friction loss tests have been made over a range of 300 to 9310 fpm in three galvanized metal ducts (8 in. ID, 8 in. square, and 4.5 x 36 in. rectangular) at equal hydraulic diameters. It is concluded that for most practical purposes rectangular ducts having aspect ratios not exceeding 8:1 will have the same static friction loss for equal lengths and mean velocities of flow as a circular duct of the same hydraulic diameter. Circular equivalents for rectangular ducts ranging from 3 x 16 in. to 88 x 96 in. are listed in a convenient table

Introduction

THE DESIGN of a ventilating or air conditioning system requires the use of rectangular duct work as a practical necessity; consequently friction loss data on such ducts are essential for design purposes.

The air friction chart for round ducts of average construction, now used in THE HEATING, VENTILATING, AIR CONDITIONING GUIDE[1], was developed by Wright from accepted work in fluid mechanics, and first presented to the Society in a research paper in 1945[2].

The present study, completed under the supervision of the subcommittee on air duct friction of the Technical Advisory Committee on Air Distribution and Air Friction, establishes a relationship between rectangular and circular ducts that enables the design engineer to estimate with a greater degree of assurance the resistance of rectangular ducts in terms of their circular equivalents and the new air friction chart.

Texts on fluid mechanics[3, 4] suggest that ducts having different cross-sectional forms but with the same ratio of cross-sectional area to perimeter will have the same friction pressure loss for equal lengths at equal mean velocities of flow. This ratio is called the hydraulic radius, and when multiplied by four, is the hydraulic or equivalent diameter. A duct of circular section will have an hydraulic diameter equal to its geometric diameter; consequently, the hydraulic diameter of a noncircular section will be equal to the geometric diameter of an equivalent circular duct.

Theories developed in studies on air flow indicate that the assumption of equal friction pressure loss for equal mean velocities in ducts of differing forms and the same equivalent diameter may not hold too well when applied either to low velocities of flow in small ducts or to ducts of extreme proportions, *i.e.* high aspect ratios.

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*Research Engineer, ASHVE Research Laboratory. Member of ASHVE.

[1] Exponent numerals refer to Bibliography.

The main purpose of this study was to check the validity of this simple criterion over a reasonably wide range of velocities and aspect ratios. The first part of the paper gives the results of an experimental investigation using three ducts of different forms but each of 8 in. equivalent diameter. The duct sizes were 8 in. ID round, 8 in. square and 4.5 in. by 36 in. rectangular (8:1 aspect ratio). Air velocities used ranged from 300 to 9310 fpm.

For most practical purposes the three ducts were found to be identical in flow resistance at equal velocities.

Part I—The Study of the Fundamental Relationship

Description of Apparatus and Tests

Ducts: The three ducts were fabricated from 16 gage galvanized sheet metal to provide the necessary rigidity against deflection.

Both the round and square ducts were constructed in 6 ft sections (Fig. 1); nine sections were flanged and bolted together to form 54 ft of straight duct. Each section was matched to the mating section by inspection of the inside joint after which two ¼ in. taper pins were installed in the flanges to insure alignment when the duct was assembled for testing. A plastic sealing material was used between flanges, and the joint was inspected for extrusion of the sealing material on the inside.

To prevent excessive deflection and reduction in area as the suction pressure was increased, the rectangular duct was braced externally. This duct was constructed in five, 10 ft lengths and was matched and sealed, as noted, to form 50 ft of straight duct.

Quantities Measured: The quantities that determine the friction pressure loss in a straight duct are mean air velocity; air temperature, humidity and pressure; duct cross-sectional dimensions, length, and surface roughness.

Mean Air Velocity: The mean air velocity was determined from the measurement of the air quantity and the duct area. For the velocity range over which each duct was tested see Table 1.

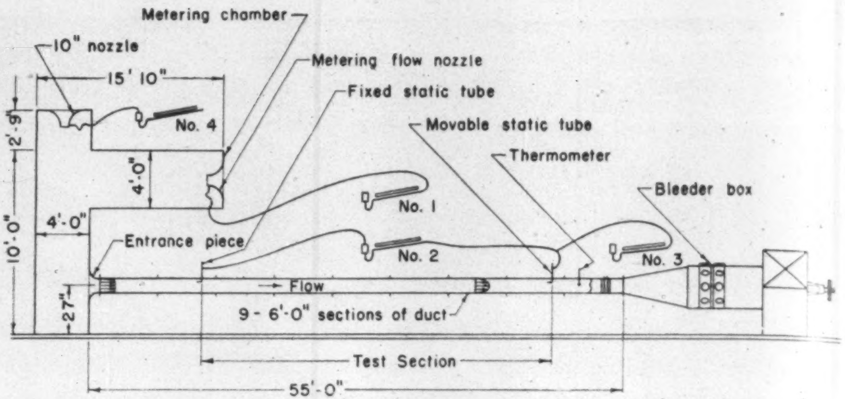

Fig. 1—Details of duct, flow measuring and flow producing equipment

Air Quantity: Air quantity was measured by the use of five cast aluminum nozzles made approximately to *ASME* long-radius, low-ratio proportions and equipped with throat static taps. The nozzles were installed in a chamber constructed according to the *ASME* 1940 Power Test Code proportions[5] for confined discharge from an infinite region.

The nozzles were calibrated in place by impact tube traverses at the throat over the full flow range[6]. Though the nozzle coefficient was found to be variable with flow rate, a constant coefficient of 0.99 approximated the variable coefficient within ± 0.41 percent over the test range. The estimated error in any flow measurement due to all sources, including the assumption of constant nozzle coefficient, did not exceed ± 2 percent. Flow ranges for the five nozzle sizes overlapped appreciably. Friction pressure loss data taken in the overlapping region for either of the two nozzle sizes were found to be identical when plotted and compared at the same mean air velocity in the duct.

The rectangular duct tests required the simultaneous use of the 9 in. and 10 in. nozzles in the metering chamber for mean air velocities over 5330 fpm. The larger nozzle was mounted in the chamber as shown in Fig. 1.

Leakage flow measurements were made before and after each duct was tested. Leakage never exceeded 0.4 percent of the minimum flow rate used in any test on any one duct. The leakage rate was obtained by sealing off the nozzle and the duct at the fan end and measuring the rate of air exhaustion produced by a small blower as indicated by a gas meter when a constant suction pressure was maintained in the system.

Duct Area: Duct dimensions were obtained at the center of representative 2 ft sections along the entire length of the test section. The average dimensions and calculated areas of the three ducts are given in Table 1.

The range of dimensions given for the rectangular duct occurs as the result of duct deflection caused by pressure difference, although the duct was strongly braced. Measurements of duct area and suction pressure established a relationship by which the actual duct area could be calculated for any given suction pressure. Data were calculated upon the basis of actual area of the duct, determined by the average internal suction pressure in the test section.

For the round and square ducts, no significant decrease in duct area was caused by pressure difference.

Table 1—Dimensions and Areas of Test Ducts

Duct	Average dimensions[a] in.	Area sq ft	Hydraulic diameter in.	Velocity range for which ducts were tested fpm
Round	8.02	0.351	8.02	749–9310
Square	7.88	0.431	7.88	808–8540
Rectangular	(4.46 ± .06) × 36	1.13–1.10	8.03–7.83	300–7950

[a] Dimensions are ± 0.02 in.

Velocity Traverses: A 0.10 in. diameter Pitot-static tube of Prandtl's proportions[7] was used to make traverses within the ducts at several velocities and locations along the duct length.

Static Friction Pressure Gradient

Experimental Technique: At a sufficient distance downstream from the entrance to the duct, the static friction pressure drop is proportional to duct length. The friction pressure drop in inches of water may then be expressed as the loss per foot of duct length and may be termed the static friction pressure gradient.

Surging of the pressures within the duct made it desirable to determine static pressures not with respect to the atmosphere but differentially with respect to another static pressure location along the duct length. In this manner the pressure surges affect both locations similarly, the pressure difference remaining fairly constant.

Static Taps: Soon after testing commenced it was apparent that the 3/64 in. wall static tap openings could not be used for the square duct. Investigation showed that surface conditions near the tap had a great influence upon the indicated static pressure, especially at the maximum velocities, although the irregularity or waviness of the wall could be detected only by very careful examination.

Static Tubes: The static holes of the Pitot-static tube described earlier in this report were used to measure duct static pressures and were found satisfactory for the round and square ducts.

The larger area of the rectangular duct permitted a larger Pitot-static tube to be used thus giving the advantage of quicker gage response. Two 0.25 in. Pitots of Standard Pitot Tube proportions[8] were found to be satisfactory and were used with a hook gage for the low velocity tests.

Static pressure explorations made within the rectangular duct on a single plane perpendicular to the long axis of the duct disclosed no measurable variation over the cross-section. A single internal static pressure taken at the axis of the duct at several locations along the duct length served to define the static friction pressure gradient.

It was found that insertion of the tubes into the duct caused sufficient resistance to decrease the air flow in the round and square ducts. Since this effect was negligible when insertion was less than 2 in. the tubes were never inserted for more than 2 in. Openings for static tube insertion were located every 3 ft along the length of the duct.

Pressure Measurements: Five well-type inclined manometers were constructed, mounted on a single panel, and filled with colored distilled water. Four of these had a range of 10 in. of water, the fifth had a range of 15 in. of water. The maximum sensitivity of the five gages was ± 0.02 in. of water, with an accuracy within this value over the entire range. For pressures less than 1 in. of water two instruments were used. One of these was a hook gage with a 1 in. range and a maximum error of ± 0.001 in. of water, the other was an inclined draft gage of 1 in. range and an over-all maximum error of ± 0.002 in. of water when calibrated with the hook gage.

Air Conditions: These were defined by measurement of the ambient wet and dry bulb temperatures, barometric pressure and duct air temperature. The density of the dry air and water vapor mixture flowing in the duct was determined from the absolute pressure in the duct at the midpoint of its length, the duct air temperature and the ambient wet and dry bulb temperatures.

Surface Roughness: The internal roughness of all three ducts was typical of galvanized iron, very little roughness was contributed by the joints. The hydraulic roughness magnitude cannot be measured geometrically but can be deduced from test results[9].

General Arrangement and Control of Equipment

A schematic drawing of the equipment layout is shown in Fig. 1. The metering nozzle discharges into the metering chamber as shown. Because of space limitations the 15 ft 10 in. duct section following the nozzle could not be laid out in a straight line with the duct; the air entered the duct through a smooth rounded entrance piece. The duct was joined to an expansion fitting and then to the bleeder box. Flow control was obtained by adjusting bleeder openings at the fan inlet and by throttling of the fan discharge.

Test Procedure

Fig. 1 also shows the gage arrangement with gage No. 1 measuring the static pressure at the throat of the nozzle, gage No. 2 measuring the differential pressure between a fixed upstream static tube and the movable downstream tube, and gage No. 3 measuring the static suction pressure relative to the atmosphere at the downstream station. The 10 in. nozzle is shown with gage No. 4 measuring the throat pressure.

A test was completed by installing the proper nozzle size, adjusting the flow for the required duct air velocity and obtaining static pressure and static differential pressures at each duct station. The nozzle static pressure and duct air temperature

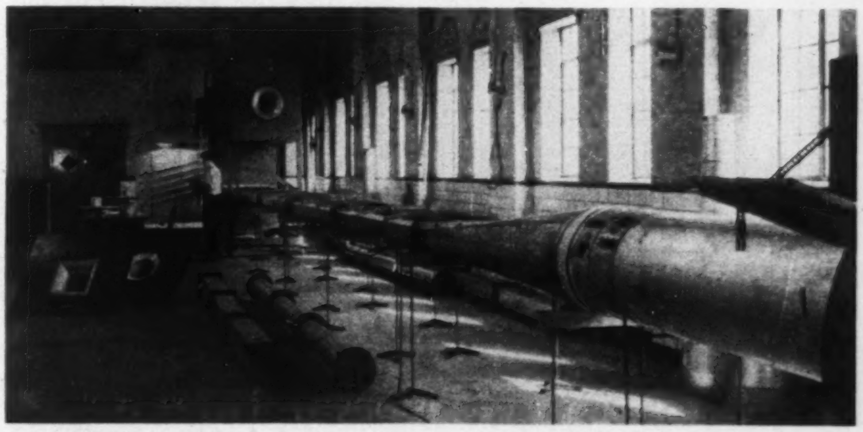

Fig. 2—General arrangement of test equipment for determining air duct friction equivalents

were read several times in the course of a test. The general arrangement of the test equipment is shown in Fig. 2.

Results and Significance of the Tests

The form of the Darcy-Weisbach equation[10] leads to the method of plotting used in Fig. 3. In general the quantity $h_f/(L/D)$ represents the friction pressure head loss for a duct of any size and for a length equal to its hydraulic diameter. The quantity $V^2/2g$ is the velocity head determined from the mean air velocity in the given duct.

Specifically, Fig. 3 presents data for three ducts of nearly equal hydraulic diameter. The test results are tabulated in Tables 2, 3 and 4. Obviously fabrication tolerances and duct deflection make it impossible to have all three ducts with exactly the same equivalent diameter.

The Darcy-Weisbach resistance coefficient or friction factor may be determined as the ratio of the head loss quantity to the velocity head quantity. The friction factor for round duct is dependent upon the roughness of duct surface relative to duct diameter and the Reynolds number, which expresses the type of duct flow for the given air conditions, duct size and mean air velocity. The three curves of Fig. 3 indicate differences in the magnitude and variation of friction factor with Reynolds number. The slightly higher loss for the rectangular duct may be influenced by increased turbulence losses occurring as the result of secondary flow[11].

A relative roughness very nearly typical of smooth pipe is indicated for the round and square ducts as determined by plotting friction factors at the corresponding Reynolds numbers on the Moody-Rouse chart[12]. The friction factors for the rectangular duct were approximately 10 percent higher than the friction factors for smooth pipe over the entire Reynolds number range. The Reynolds number for these tests ranged from 18,600 to 589,000 and corresponded to flow of the transitional type.

Points below a velocity head of 2.42 ft of air (Fig. 3) are extrapolated for the round and square ducts on the basis of the friction factor typical of smooth pipe.

The small variations in the hydraulic diameters of the ducts from a mean value of 8.00 in., as noted in Table 1, have a negligible effect upon the friction factor due to relative roughness or Reynolds number change and cannot possibly account for the differences in the three sets of data.

In Fig. 4 the curves of Fig. 3 are replotted. The friction pressure loss term is expressed as friction pressure loss in inches of water for

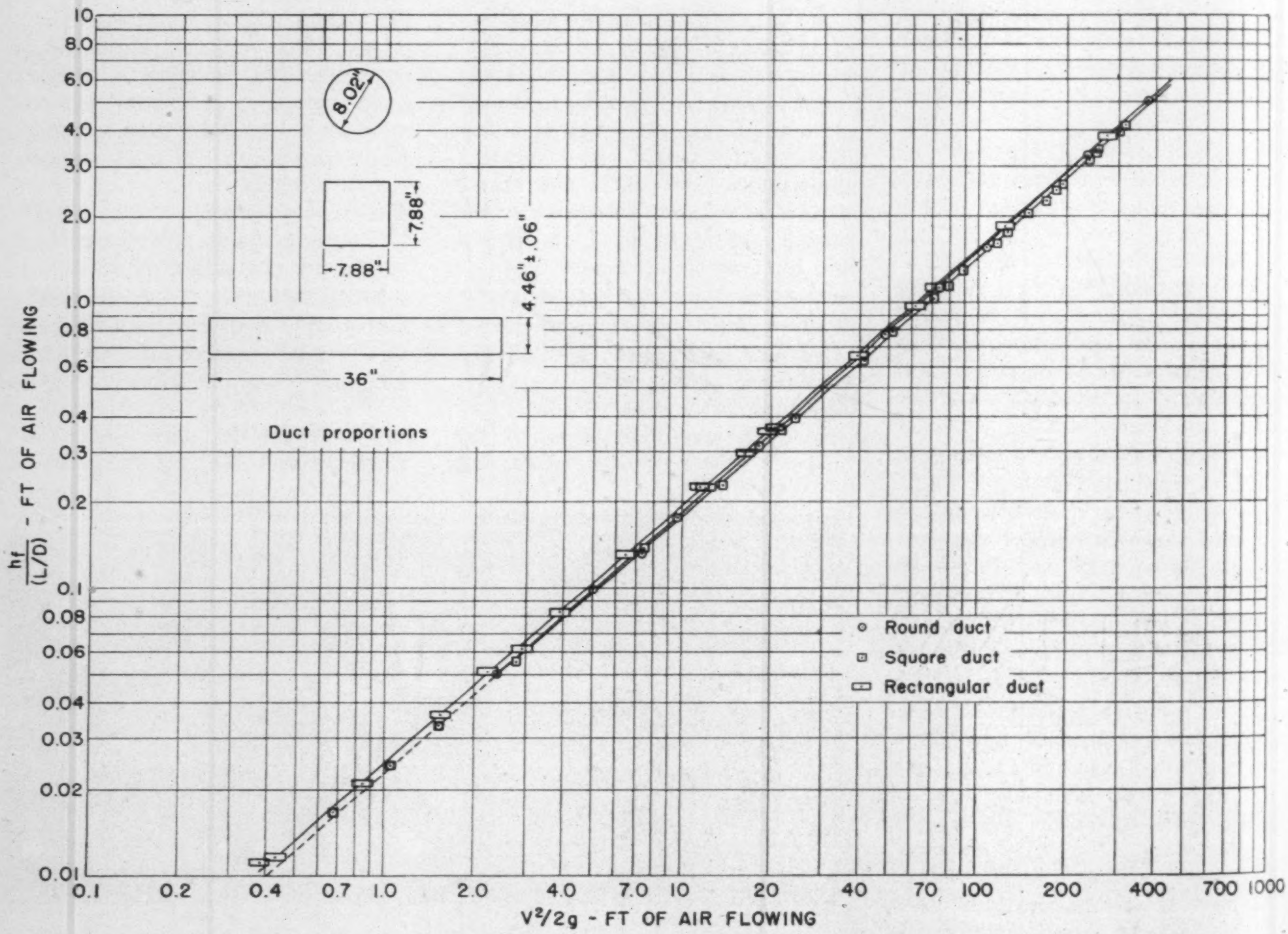

Fig. 3—Comparison of friction pressure loss in round, square and rectangular ducts

standard air per 100 ft of 8.00 in. equivalent diameter duct. The velocity head term has been replaced by the velocity of standard air to facilitate conclusions in terms familiar to the design engineer. *The small variation in head loss at a given velocity for the three ducts is negligible for most practical purposes.* The maximum variation is ± 5.0 percent from the mean value.

Related to the frictional loss of pressure in long ducts are the increased duct losses caused by turbulence and velocity transformation near the entrance[13]. Referring to Fig. 1, immediately following the entrance piece the distribution of flow over the cross-section of the duct is uniform. At a downstream location, the velocity in the neighborhood of the duct surface is less than the average velocity in the cross-section and, consequently, the center velocity must be accelerated in accordance with the requirements for continuity of flow. The decrease in flow velocity near the duct surface is the result of skin

Table 2—Summary of Test Results on Round Duct

Test No.	Nozzle throat diam	Air temp	Duct static pressure	Duct air density	Mean air velocity	Hydraulic diam of duct	Static pressure gradient	$h_f/(L/D)$	$V^2/2g$	R_e	f
	in.	F	in. w.g.	lb/cu ft	fpm	in.	in. w.g./ft	ft of duct air	ft of duct air		
2..........	9	73	12.71	0.0694	9310	8.02	0.1011	5.07	374	5.89×10^5	0.0136
3..........	9	74	7.60	0.0697	7380	8.02	0.0653	3.26	235	4.69×10^5	0.0139
4..........	6	71	7.17	0.0695	4990	8.02	0.0313	1.57	107	3.18×10^5	0.0146
5..........	6	72	3.69	0.0701	3350	8.02	0.0155	0.769	49.0	2.14×10^5	0.0154
6..........	4	69	4.51	0.0707	2070	8.02	0.00636	0.313	18.4	1.34×10^5	0.0170
7..........	4	70	2.41	0.0710	1500	8.02	0.00364	0.179	9.73	9.78×10^4	0.0183
8..........	4	70	1.24	0.0711	1080	8.02	0.00204	0.0998	5.04	7.06×10^4	0.0198
9..........	4	70	0.59	0.0712	749	8.02	0.00103	0.0502	2.42	4.87×10^4	0.0207
10..........	4	70	2.24	0.0720	1310	8.02	0.00276	0.133	7.41	8.64×10^4	0.0180

Table 3—Summary of Test Results on Square Duct

Test No.	Nozzle throat diam	Air temp	Duct static pressure	Duct air density	Mean air velocity	Hydraulic diam of duct	Static pressure gradient	$h_f/(L/D)$	$V^2/2g$	R_e	f
	in.	F	in. w.g.	lb/cu ft	fpm	in.	in. w.g./ft	ft of duct air	ft of duct air		
1..........	9	74	11.09	0.0702	8540	7.88	0.0862	4.19	314	5.32×10^5	0.0133
2..........	9	71	9.19	0.0715	7670	7.88	0.0704	3.36	254	4.91×10^5	0.0132
3..........	9	70	7.07	0.0720	6530	7.88	0.0526	2.49	184	4.21×10^5	0.0135
4..........	9	70	5.04	0.0717	5420	7.88	0.0372	1.77	127	3.48×10^5	0.0140
5..........	9	71	3.18	0.0721	4140	7.88	0.0240	1.13	74.0	2.68×10^5	0.0153
6..........	6	71	6.80	0.0718	4060	7.88	0.0217	1.03	71.2	2.61×10^5	0.0145
7..........	6	72	8.22	0.0708	4540	7.88	0.0268	1.29	88.9	2.88×10^5	0.0145
8..........	6	73	5.04	0.0714	3470	7.88	0.0166	0.791	52.0	2.22×10^5	0.0152
9..........	6	76	2.54	0.0706	2370	7.88	0.00819	0.395	24.2	1.49×10^5	0.0163
10..........	6	77	1.59	0.0708	1790	7.88	0.00479	0.230	13.9	1.13×10^5	0.0166
11..........	4	75	7.71	0.0698	2260	7.88	0.00735	0.359	22.0	1.40×10^5	0.0163
12..........	4	71	1.36	0.0716	808	7.88	0.00117	0.0558	2.82	5.19×10^4	0.0198
13..........	4	73	2.67	0.0710	1320	7.88	0.00290	0.139	7.54	8.39×10^4	0.0184
14..........	7	75	10.89	0.0692	6720	7.88	0.0526	2.59	194	4.15×10^5	0.0134
15..........	7	72	9.81	0.0696	6510	7.88	0.0508	2.49	183	4.06×10^5	0.0136
16..........	7	76	9.52	0.0692	6270	7.88	0.0463	2.28	170	3.85×10^5	0.0134
17..........	7	76	6.72	6.0697	5210	7.88	0.0329	1.61	117	3.22×10^5	0.0138
18..........	7	77	4.62	0.0694	4300	7.88	0.0231	1.13	79.8	2.65×10^5	0.0142
19..........	7	77	2.37	0.0697	3090	7.88	0.0128	0.625	41.2	1.91×10^5	0.0152
20..........	9	73	10.91	0.0694	8540	7.88	0.0839	4.12	315	5.31×10^5	0.0131
21..........	9	75	10.42	0.0694	8350	7.88	0.0807	3.96	301	5.15×10^5	0.0132
22..........	9	75	8.89	0.0696	7670	7.88	0.0689	3.37	254	4.73×10^5	0.0133
23..........	9	76	9.05	0.0696	7720	7.88	0.0703	3.44	257	4.77×10^5	0.0134
24..........	9	76	8.34	0.0695	7440	7.88	0.0643	3.15	239	4.59×10^5	0.0132
25..........	9	77	5.35	0.0701	5870	7.88	0.0417	2.03	149	3.65×10^5	0.0136

Table 4—Summary of Test Results on Rectangular Duct

Test No.	Nozzle throat diam	Air temp	Duct static pressure	Duct air density	Mean air velocity	Hydraulic diam of duct	Static pressure gradient	$h_f/(L/D)$	$V^2/2g$	R_e	f
	in.	F	in. w.g.	lb/cu ft	fpm	in.	in. w.g./ft	ft of duct air	ft of duct air		
2..........	9	79	6.51	0.0699	3780	7.92	0.0197	0.970	61.6	2.36×10^5	0.0158
3..........	9	78	7.41	0.0693	4070	7.87	0.0228	1.13	71.2	2.50×10^5	0.0158
5..........	9	77	1.81	0.0706	1950	8.02	0.00602	0.296	16.4	1.25×10^5	0.0180
6..........	9	76	4.21	0.0703	3010	7.95	0.0132	0.648	39.1	1.90×10^5	0.0166
7..........	7	77	5.26	0.0698	2200	7.94	0.00740	0.365	20.8	1.38×10^5	0.0175
8..........	7	78	3.14	0.0705	1670	7.99	0.00458	0.225	12.1	1.06×10^5	0.0186
14..........	4	83	0.86	0.0688	300	8.03	0.000222	0.0112	0.388	1.86×10^4	0.0290
15..........	4	74	6.40	0.0696	825	7.92	0.00126	0.0618	2.94	5.15×10^4	0.0210
16..........	4	74	3.57	0.0704	602	7.97	0.000739	0.0363	1.57	3.83×10^4	0.0231
17..........	4	75	1.97	0.0706	448	8.00	0.000429	0.0211	0.866	2.87×10^4	0.0244
18..........	4	75	0.98	0.0708	318	8.03	0.000238	0.0117	0.436	2.05×10^4	0.0268
19..........	6	73	1.05	0.0710	723	8.03	0.00105	0.0512	2.26	4.67×10^4	0.0226
20..........	6	75	3.05	0.0707	1230	7.98	0.00269	0.131	6.55	7.89×10^4	0.0201
21..........	7	70	1.07	0.0722	955	8.02	0.00173	0.0833	3.92	6.30×10^4	0.0212
22..........	7	70	5.08	0.0715	2140	7.93	0.00739	0.356	19.8	1.38×10^5	0.0180
23..........	9	75	1.36	0.0722	1646	8.00	0.00471	0.227	11.7	1.08×10^5	0.0194
24..........	9, 10	79	10.35	0.0698	7950	7.83	0.0785	3.82	273	4.91×10^5	0.0140
25..........	9, 10	79	4.82	0.0695	5330	7.95	0.0372	1.84	123	3.83×10^5	0.0150

friction, and the layer of air so affected is termed the boundary layer. Its thickness for a constant Reynolds number increases with the length of surface over which the air has passed until it equals one half the maximum cross-section dimension of the duct. For a given length the boundary layer thickness decreases as the mean air velocity increases. The boundary layer development is reflected by the transformation of the velocity profile along the length of the duct. The duct length required for the complete transformation of the entrance profile to the stable, fully-developed profile downstream may be defined as the entrance length.

Associated with a change in velocity profile are the increased losses due to turbulence. Any tests for duct resistance in fully-developed flow must not include the entrance length for which the losses are directly attributable to the entrance fitting. The effect of entrance fittings in common use on duct friction will be the subject of a more detailed study.

The static pressure loss occurring as the result of velocity head transformation in the duct following the entrance fitting has been reported as approximately 0.09 velocity heads[14]. This loss depends upon the form of the fully developed velocity distribution and was found to be 0.028 velocity heads for the conditions of test outlined in more detail later in this discussion. The distance required for complete transformation is not well established; values from 10 to 100 diameters have been reported for turbulent flow[15]. In terms of 8.00 in. equivalent diameter duct, entrance lengths from 7 to 67 ft would be required. Due to the smoothness of the entrance piece and lack of turbulence upon entry, the longer length is probably the more typical for these tests.

Since velocity head transformation probably occurred over the complete length of duct tested a check was made on the effectiveness of the transformation in increasing the static pressure loss. Two traverses at opposite ends of the round duct indicated different velocity profiles, the centerline velocity at the downstream end was 6.6 percent higher than at the upstream end for a mean velocity of 9310 fpm. The velocity head difference occurring as the result of the velocity transformation was found to be negligible. The velocity head at a given traverse station was determined by plotting velocity pressure obtained by traverse *vs.* the square of the radial distance from duct axis to traverse point and calculating the average value of the resulting curve by integration and division by the base length. To substantiate further the lack of effective increase in static pressure loss due to velocity profile transformation, the friction loss measured in these ducts was found to be typical of smooth pipe and consequently no smaller loss is physically possible.

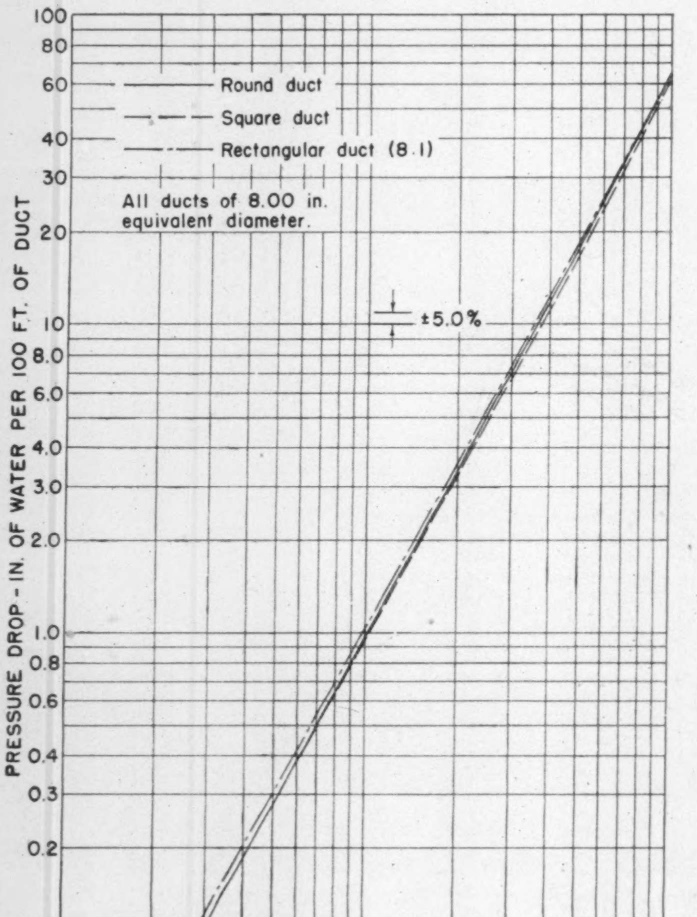

Fig. 4—Comparison of friction pressure loss in inches of water for 100 ft of 8.00 in. equivalent diameter round, square and rectangular ducts

Part II—Circular Equivalents of Rectangular Ducts for Equal Friction at Equal Capacities

The practical use of a relationship which expresses form equivalence demands that the static friction pressure losses for rectangular ducts and their circular equivalents be equal for equal lengths and equal cfm capacities. For a given length and capacity the friction pressure loss of a rectangular duct must be equal to the friction pressure loss of an equivalent circular duct of the same length and capacity. When the duct sizes are expressed in terms of hydraulic diameter, equating these pressure loss expressions leads to a relationship between the dimensions of the rectangular duct and its circular equivalent. Tables of the circular equivalents of rectangular ducts for equal friction and capacity based on the results obtained in this study are included.

Derivation of Circular Equivalents' Relationship for Rectangular Ducts

The equivalent diameter, *D*, has been given as:

$$D = \frac{4A}{P} \quad \text{.....................} \quad (1)$$

where

A = cross-sectional area of duct in inches

P = perimetric length of cross-section in inches

In the case of a circular duct, the equivalent diameter may be shown to be equal to the geometric diameter. For a rectangular duct,

$$D=\frac{4ab}{2(a+b)}=\frac{2ab}{(a+b)}=\frac{2b\,A_r}{A_r+1} \qquad \text{(2)}$$

where

a = width of duct in inches

b = depth of duct in inches

A_r = aspect ratio or ratio of duct width to depth

The area of a rectangular duct can be expressed in terms of aspect ratio and hydraulic diameter as:

$$A=\frac{D^2\,(A_r+1)^2}{4A_r} \qquad \text{(3)}$$

from which it can be seen that for constant hydraulic diameter (1) the area of a square duct is greater than the area of a circular duct and (2) the area of a rectangular duct increases with increasing aspect ratio. As a consequence of the larger area of the rectangular duct, the use of the hydraulic diameter theory for friction equivalence requires that a greater cfm flow rate will be necessary in a rectangular or square duct than in a circular duct to obtain equal mean air velocities.

The exponential equation expressing the pressure loss in the foregoing terms is determined from the air friction chart developed by Wright[1]. The curved and nonparallel lines of the chart can be approximated reasonably well by a series of straight, parallel lines for which an equation can easily be determined. The area of the chart corresponding to duct sizes between 4 in. and 38 in. and mean air velocities between 350 and 2400 fpm is most commonly used. With an error of not more than 3.0 percent, this area of the chart may be represented by the exponential equation:

$$\Delta p = 0.027\,\frac{L}{D^{1.23}}\left(\frac{V}{1000}\right)^{1.845} \qquad \text{(4)}$$

where

Δp = friction pressure loss in inches of water for a duct of length L

L = duct length in feet

D = diameter of round duct in inches

V = mean air velocity in feet per minute

From the conclusions of Part I the pressure loss in the rectangular duct may be expressed as,

$$\Delta p = 0.027L\left(\frac{a+b}{2ab}\right)^{1.23}\left(\frac{V}{1000}\right)^{1.845} \qquad \text{(5)}$$

where

a = duct width in inches

b = duct length in inches

Equating friction pressure losses at equal capacities for equal lengths:

$$0.027L\left(\frac{a+b}{2ab}\right)^{1.23}\left(\frac{144Q}{1000ab}\right)^{1.845}$$

$$=0.027L\left(\frac{1}{D}\right)^{1.23}\left(\frac{4\text{x}144Q}{1000\pi D^2}\right)^{1.845}$$

from which

$$D_e = 1.30\,\frac{(ab)^{0.625}}{(a+b)^{0.250}}$$

$$=1.30\sqrt[8]{\frac{(ab)^5}{(a+b)^2}} \qquad \text{(6)}$$

where

D_e = circular equivalent in inches of a rectangular duct for equal friction and capacity.

Madison[16] proposed an exponential equation fitting the body of the air friction chart from which the circular equivalent relationship for rectangular ducts could be calculated. Madison's form of the final relationship gave a circular equivalent differing less than one percent from the above form for an aspect ratio of 9:1.

Table 5 gives the circular equivalents of rectangular ducts for aspect ratios not greater than 11.7:1.

Summary

Part I — Three galvanized iron ducts of approximately 8 in. equivalent diameter with very little roughness contributed by the joints were tested for friction pressure loss in equal lengths at equal velocities of flow. The ducts tested were 8 in. round, 8 in. square and 4.5 x 36 in. rectangular (8:1 aspect ratio).

It may be concluded from the tests that:

1. The friction factors for the three ducts were very nearly typical of smooth pipe.
2. The maximum variation from the mean static friction pressure loss, at a mean air velocity between 300 and 9000 fpm for the three ducts, corrected to an 8.00 in. equivalent diameter, did not exceed ± 5.0 percent.
3. There was no measurable increase in the indicated duct loss due to velocity head transformation.
4. For most practical purposes rectangular ducts of aspect ratios not exceeding 8:1 will have the same static friction pressure loss for equal lengths and mean velocities of flow as a circular duct of the same hydraulic diameter.

Part II — From an exponential equation relating the quantities in the ASHVE friction chart (The Guide 1947) over the velocity range and duct size range most commonly used (*i.e.* 350 to 2400 fpm and 4 to 38 in.), and by the use of the final conclusion of Part I applied to ducts of commercial construction, an equation was derived giving the circular equivalent of a rectangular duct for equal friction and capacity.

This equation was used to calculate Table 5 which gives circular equivalents of rectangular ducts for equal friction and capacity for rectangular ducts from 3 in. by 4 in. to 88 in. by 96 in. Aspect ratios between 8:1 and the maximum 11.7:1 are tabulated for discriminate use when ducts between these proportions must be used.

Appendix

Brief Theory of Duct Flow

The relationship between the aforementioned quantities affecting friction pressure loss in straight ducts is expressed in the following Darcy-Weisbach equation[10],

$$h_f = f\,\frac{L}{D}\,\frac{V^2}{2g} \qquad (a)$$

where

h_f = the friction pressure loss in feet of air over the distance L

L = the duct length in feet

D = the hydraulic diameter in feet

V = the mean air velocity in feet per second

g = the acceleration due to gravity or 32.16 feet per (second) (second)

f = the Darcy-Weisbach resistance coefficient commonly called the friction factor

Equation (a) is developed from a relationship expressing the drag force upon a unit area of the duct surface exposed to a parallel moving air stream in terms of the average air velocity, density and drag coefficient as follows:

$$\tau_o = c_f\,\frac{\rho V^2}{2_g} \qquad (b)$$

where

τ_o = the drag force in pounds per square foot of surface

Table 5—Circular Equivalents of Rectangular Ducts for Equal Friction and Capacity

Side Rectangular Duct	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16
3.0	3.8	4.0	4.2	4.4	4.6	4.8	4.9	5.1	5.2	5.4	5.5	5.6	5.7	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0
3.5	4.1	4.3	4.6	4.8	5.0	5.2	5.3	5.5	5.7	5.8	6.0	6.1	6.3	6.4	6.5	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6
4.0	4.4	4.6	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.4	6.6	6.8	6.9	7.1	7.2	7.3	7.5	7.6	7.7	7.8	7.9	8.1	8.2	8.3
4.5	4.6	4.9	5.2	5.4	5.6	5.9	6.1	6.3	6.5	6.7	6.9	7.0	7.2	7.4	7.5	7.7	7.8	8.0	8.1	8.2	8.4	8.5	8.6	8.7	8.9
5.0	4.9	5.2	5.5	5.7	6.0	6.2	6.4	6.7	6.9	7.1	7.3	7.4	7.6	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	9.0	9.1	9.3	9.4
5.5	5.1	5.4	5.7	6.0	6.3	6.5	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.7	8.8	9.0	9.2	9.4	9.5	9.6	9.8	9.8

Side Rectangular Duct	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	56	60	64	68	72	76	80	84	88	Side Rectangular Duct
6	6.6																																								6
7	7.1	7.7																																							7
8	7.5	8.2	8.8																																						8
9	8.0	8.6	9.3	9.9																																					9
10	8.4	9.1	9.8	10.4	10.9																																				10
11	8.8	9.5	10.2	10.8	11.4	12.0																																			11
12	9.1	9.9	10.7	11.3	11.9	12.5	13.1																																		12
13	9.5	10.3	11.1	11.8	12.4	13.0	13.6	14.2																																	13
14	9.8	10.7	11.5	12.2	12.9	13.5	14.2	14.7	15.3																																14
15	10.1	11.0	11.8	12.6	13.3	14.0	14.6	15.3	15.8	16.4																															15
16	10.4	11.4	12.2	13.0	13.7	14.4	15.1	15.7	16.3	16.9	17.5																														16
17	10.7	11.7	12.5	13.4	14.1	14.9	15.5	16.1	16.8	17.4	18.0	18.6																													17
18	11.0	11.9	12.9	13.7	14.5	15.3	16.0	16.6	17.3	17.9	18.5	19.1	19.7																												18
19	11.2	12.2	13.2	14.1	14.9	15.6	16.4	17.1	17.8	18.4	19.0	19.6	20.2	20.8																											19
20	11.5	12.5	13.5	14.4	15.2	15.9	16.8	17.5	18.2	18.8	19.5	20.1	20.7	21.3	21.9																										20
22	12.0	13.1	14.1	15.0	15.9	16.7	17.6	18.3	19.1	19.7	20.4	21.0	21.7	22.3	22.9	24.1																									22
24	12.4	13.6	14.6	15.6	16.6	17.5	18.3	19.1	19.8	20.6	21.3	21.9	22.6	23.2	23.9	25.1	26.2																								24
26	12.8	14.1	15.2	16.2	17.2	18.1	19.0	19.8	20.6	21.4	22.1	22.8	23.5	24.1	24.8	26.1	27.2	28.4																							26
28	13.2	14.5	15.6	16.7	17.7	18.7	19.6	20.5	21.3	22.1	22.9	23.6	24.4	25.0	25.7	27.1	28.2	29.5	30.6																						28
30	13.6	14.9	16.1	17.2	18.3	19.3	20.2	21.1	22.0	22.9	23.7	24.4	25.2	25.9	26.7	28.0	29.3	30.5	31.6	32.8																					30
32	14.0	15.3	16.5	17.7	18.8	19.8	20.8	21.8	22.7	23.6	24.4	25.2	26.0	26.7	27.5	28.9	30.1	31.4	32.6	33.8	35.0																				32
34	14.4	15.7	17.0	18.2	19.3	20.4	21.4	22.4	23.3	24.2	25.1	25.9	26.7	27.5	28.3	29.7	31.0	32.3	33.6	34.8	36.0	37.2																			34
36	14.7	16.1	17.4	18.6	19.8	20.9	21.9	23.0	23.9	24.8	25.8	26.6	27.4	28.3	29.0	30.5	32.0	33.0	34.6	35.8	37.0	38.2	39.4																		36
38	15.0	16.4	17.8	19.0	20.3	21.4	22.5	23.5	24.5	25.4	26.4	27.3	28.1	29.0	29.8	31.4	32.8	34.2	35.5	36.7	38.0	39.2	40.4	41.6																	38
40	15.3	16.8	18.2	19.4	20.7	21.9	23.0	24.0	25.1	26.0	27.0	27.9	28.8	29.7	30.5	32.1	33.6	35.1	36.4	37.6	39.0	40.2	41.4	42.6	43.8																40
42	15.6	17.1	18.5	19.8	21.1	22.3	23.4	24.5	25.6	26.6	27.6	28.5	29.4	30.4	31.2	32.8	34.4	35.9	37.3	38.6	39.9	41.1	42.4	43.6	44.8	45.9															42
44	15.9	17.5	18.9	20.2	21.5	22.7	23.9	25.0	26.1	27.2	28.2	29.1	30.0	31.0	31.9	33.5	35.2	36.7	38.1	39.5	40.8	42.0	43.4	44.6	45.8	46.9	48.1														44
46	16.2	17.8	19.2	20.6	21.9	23.2	24.3	25.5	26.7	27.7	28.7	29.7	30.6	31.6	32.5	34.2	35.9	37.4	38.9	40.3	41.7	43.0	44.3	45.6	46.8	47.9	49.1	50.3													46
48	16.5	18.1	19.6	20.9	22.3	23.6	24.8	26.0	27.2	28.2	29.2	30.2	31.2	32.2	33.1	34.9	36.6	38.2	39.7	41.2	42.6	43.9	45.2	46.5	47.8	48.9	50.2	51.3	52.6												48
50	16.8	18.4	19.9	21.3	22.7	24.0	25.2	26.4	27.6	28.7	29.8	30.8	31.8	32.8	33.7	35.5	37.3	38.9	40.4	42.0	43.5	44.8	46.1	47.4	48.8	49.8	51.2	52.3	53.6	54.7											50
52	17.0	18.7	20.2	21.6	23.1	24.4	25.6	26.8	28.1	29.2	30.3	31.4	32.4	33.4	34.3	36.2	38.0	39.6	41.2	42.8	44.3	45.7	47.1	48.3	49.7	50.8	52.2	53.3	54.6	55.8	56.9										52
54	17.3	19.0	20.5	22.0	23.4	24.8	26.1	27.3	28.5	29.7	30.8	31.9	32.9	33.9	34.9	36.8	38.7	40.3	42.0	43.6	45.0	46.5	48.0	49.2	50.6	51.8	53.2	54.3	55.6	56.8	57.9										54
56	17.6	19.3	20.9	22.4	23.8	25.2	26.5	27.7	28.9	30.1	31.2	32.4	33.4	34.5	35.5	37.4	39.3	41.0	42.7	44.3	45.8	47.3	48.8	50.1	51.5	52.7	54.1	55.3	56.5	57.8	58.9	61.3									56
58	17.8	19.5	21.1	22.7	24.2	25.5	26.9	28.2	29.3	30.5	31.7	32.9	33.9	35.0	36.0	38.0	39.8	41.7	43.4	45.0	46.6	48.1	49.6	51.0	52.4	53.7	55.0	56.2	57.5	58.8	60.0	62.3									58
60	18.1	19.8	21.4	23.0	24.5	25.8	27.3	28.7	29.8	31.0	32.2	33.4	34.5	35.5	36.5	38.6	40.4	42.3	44.0	45.8	47.3	48.9	50.4	51.8	53.3	54.6	55.9	57.1	58.5	59.8	61.0	63.3	65.7								60
62	18.3	20.1	21.7	23.3	24.8	26.2	27.6	29.0	30.2	31.4	32.6	33.8	35.0	36.0	37.1	39.2	41.0	42.9	44.7	46.5	48.0	49.7	51.2	52.6	54.2	55.5	56.8	58.0	59.4	60.7	62.0	64.3	66.7								62
64	18.6	20.3	22.0	23.6	25.2	26.5	27.9	29.3	30.6	31.8	33.1	34.2	35.5	36.5	37.6	39.7	41.6	43.5	45.4	47.2	48.7	50.4	52.0	53.4	55.0	56.4	57.7	59.0	60.3	61.6	62.9	65.3	67.7	70.0							64
66	18.8	20.6	22.3	23.9	25.5	26.9	28.3	29.7	31.0	32.2	33.5	34.7	35.9	37.0	38.1	40.2	42.2	44.1	46.0	47.8	49.5	51.1	52.8	54.2	55.8	57.2	58.6	59.9	61.2	62.5	63.9	66.3	68.7	71.1							66
68	19.0	20.8	22.5	23.2	25.8	27.3	28.7	30.1	31.4	32.6	33.9	35.1	36.3	37.5	38.6	40.7	42.8	44.7	46.6	48.4	50.2	51.8	53.5	55.0	56.6	58.0	59.5	60.8	62.1	63.4	64.8	67.3	69.7	72.1	74.4						68
70	19.2	21.1	22.8	23.5	26.1	27.6	29.1	30.4	31.8	33.1	34.3	35.6	36.8	37.9	39.1	41.3	43.3	45.3	47.2	49.0	50.9	52.5	54.2	55.8	57.3	58.8	60.3	61.7	63.0	64.3	65.7	68.3	70.7	73.1	75.4						70
72															39.6	41.8	43.8	45.9	47.8	49.7	51.5	53.2	54.9	56.5	58.0	59.6	61.1	62.6	63.9	65.2	66.6	69.2	71.7	74.1	76.4	78.8					72
74															40.0	42.3	44.4	46.4	48.4	50.3	52.1	53.9	55.6	57.2	58.8	60.4	61.9	63.3	64.8	66.1	67.5	70.1	72.7	75.1	77.4	79.9					74
76															40.5	42.8	44.9	47.0	49.0	50.8	52.7	54.6	56.3	57.9	59.5	61.2	62.7	64.1	65.6	67.0	68.4	71.0	73.6	76.1	78.4	80.9	83.2				76
78															40.9	43.3	45.5	47.5	49.5	51.5	53.3	55.2	57.0	58.6	60.3	62.0	63.4	64.9	66.4	67.9	69.3	71.8	74.5	77.1	79.4	81.8	84.2				78
80															41.3	43.8	46.0	48.0	50.1	52.0	53.9	55.8	57.6	59.3	61.0	62.7	64.1	65.7	67.2	68.7	70.1	72.7	75.4	78.1	80.4	82.8	85.2	87.5			80
82															41.8	44.2	46.4	48.6	50.6	52.6	54.5	56.4	58.2	60.0	61.7	63.4	64.9	66.5	68.0	69.5	71.0	73.6	76.3	79.0	81.4	83.8	86.2	88.6			82
84															42.2	44.6	46.9	49.2	51.1	53.2	55.1	57.0	58.9	60.7	62.4	64.1	65.7	67.3	68.8	70.3	71.8	74.5	77.2	79.9	82.4	84.8	87.2	89.6	91.9		84
86															42.6	45.0	47.4	49.6	51.6	53.7	55.7	57.6	59.5	61.3	63.0	64.8	66.4	68.0	69.5	71.1	72.6	75.4	78.1	80.8	83.3	85.8	88.2	90.6	92.9		86
88															43.0	45.4	47.9	50.1	52.2	54.3	56.3	58.2	60.1	62.0	63.7	65.4	67.0	68.7	70.3	71.8	73.4	76.3	79.0	81.6	84.2	86.8	89.2	91.6	93.9	96.3	88
90															43.4	45.9	48.3	50.6	52.8	54.8	56.9	58.8	60.7	62.6	64.4	66.0	67.8	69.4	71.1	72.6	74.2	77.1	79.9	82.5	85.1	87.8	90.2	92.6	94.9	97.3	90
92															43.8	46.3	48.7	51.1	53.4	55.4	57.4	59.4	61.3	63.2	65.0	66.8	68.5	70.1	71.8	73.3	74.9	77.8	80.8	83.4	86.0	88.7	91.2	93.6	95.9	98.3	92
94															44.2	46.7	49.1	51.6	53.9	55.9	57.9	60.0	61.9	63.8	65.6	67.5	69.2	70.8	72.5	74.1	75.6	78.6	81.7	84.3	86.9	99.6	92.1	94.6	96.9	99.3	94
96															44.6	47.2	49.5	52.0	54.4	56.3	58.4	60.5	62.4	64.4	66.2	68.2	69.8	71.5	73.2	74.8	76.3	79.4	82.6	85.2	87.8	90.5	93.0	95.6	97.9	100.3	96

ρ = the air density in pounds per cubic foot

V = the mean air velocity relative to the boundary surface in feet per second

c_f = the drag coefficient

To evaluate the total drag on the inside of a duct of perimeter P and length L the total drag force on the surface area PL is,

$$F = PL\, c_f \frac{\rho V^2}{2g}, \text{ or}$$

$$F = PL \frac{f}{4} \frac{\rho V^2}{2g} \quad \ldots\ldots\ldots\ldots\ldots (c)$$

where

F = the total drag force upon the duct surface

$f = 4c_f$

Consider the forces upon an isolated length of duct L. The difference between the force at the upstream end of the duct and the lesser force at the downstream end maintains flow. For dynamic equilibrium the force opposing flow or total drag force must be equal to the force maintaining flow,

$$F = (p_1 - p_2)\, A \quad \ldots\ldots\ldots\ldots (d)$$

where

p_1 and p_2 = the static pressure at the ends of the duct length, L, in pounds per square foot

A = the cross-sectional area of the duct

From Equations (*c*) and (*d*)

$$p_1 - p_2 = \Delta p = f \frac{L}{(4A/P)} \frac{\rho V^2}{2g} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (e)$$

Equation (*e*) may also be expressed in head loss in feet of the fluid flowing,

$$h_f = f \frac{L}{(4A/P)} \frac{V^2}{2g} \quad \ldots\ldots\ldots\ldots (f)$$

which is Equation (*a*) with D replaced by the equivalent quantity $4A/P$.

It is to be noted for a duct of circular section the quantity,

$$\frac{4A}{P} = 4 \frac{\pi D^2}{4} \frac{1}{\pi D}$$

equals the geometric diameter and when expressed as in Equation (*e*) may be the hydraulic diameter of a noncircular section as noted earlier.

The Reynolds number for duct flow expresses the ratio of the magnitude of the quantities increasing the turbulence of flow to the magnitude of the quantities increasing dampening of the turbulence:

$$R_e = \frac{DV}{\nu} \quad \ldots\ldots\ldots\ldots\ldots\ldots (g)$$

where

R_e = Reynolds number, dimensionless

D = the hydraulic diameter of the duct cross-section in feet

V = mean air velocity in feet per second

ν = kinematic viscosity of the air in feet per (second) (second)

For a Reynolds number less than 2000 the flow is viscous and all turbulence is completely dampened out, whereas for Reynolds numbers greater than 2000, the viscous action of the fluid is generally ineffective and turbulence persists in the main body of the flow stream.

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14. Reference 7, p. 51
15. Reference 7, p. 49
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JOURNAL SECTION

J. H. WALKER RECEIVES F. PAUL ANDERSON MEDAL

The Council of the American Society of Heating and Ventilating Engineers has awarded the F. Paul Anderson Medal to James Herbert Walker, vice president, The Detroit Edison Co., Detroit Mich., for his outstanding contributions to the advancement of heating, ventilating and air conditioning and for his many distinguished services to the ASHVE as an engineer, executive, author and officer of the Society.

J. H. Walker
Detroit, Mich.

Mr. Walker was employed by the Detroit Edison Co. in 1912, following his graduation from the University of Michigan with a degree in mechanical engineering. For many years he was superintendent of the company's central heating department, following which he was assistant to the general manager. He was elected a vice president of the company in March 1945.

Mr. Walker is an honorary member and past president of the *National District Heating Association*, is the author of a number of papers on heating and ventilating, and is the co-author of a textbook on the subject. He joined the ASHVE in 1916, has served as Vice President, chairman of the Committee on Research, chairman of the Guide Publication Committee, Finance, Standards, Executive, and many other technical committees.

THE F. PAUL ANDERSON

Nominees for 1948 Committee on Research

Three-Year Term

Axel B. Algren, Minneapolis, Minn., associate professor and head of the heating, ventilating and air conditioning division at the University of Minnesota's Engineering Experiment Station, was born on October 14, 1893, in Minneapolis, Minn. He graduated from the University of Minnesota, with a B.S. degree in 1925 and received his M.S. degree in 1931. Following his graduation from the University he joined the A. T. Rydell Sash and Door Co., as a superintendent, engaged in factory supervision and installation. In 1927 he became a research assistant at the University of Minnesota, where his work dealt mainly with heat transmission research.

A. B. Algren
Minneapolis, Minn.

Since joining the ASHVE in 1930, Professor Algren has been active in the affairs of the Society, serving as a member of the Technical Advisory Committee on Heat Transmission during 1932 and 1933, and currently as a member of the 1947 TAC on Glass, and as alternate on the Chapter Delegates Committee. He has also served as president, vice president, secretary, treasurer, and as a member of the board of governors of the Minnesota Chapter, as well as a member of several chapter committees including, program, membership and legislative committees.

In addition to the ASHVE, Professor Algren holds membership in the *American Society for Engineering Education, American Association of University Professors, Minnesota Association of Professional Engineers,* Minneapolis Engineer's Club, Sigma Xi, Pi Tau Sigma, Disabled American Veterans, American Legion, and the *Army Ordnance Association.*

He has written numerous articles on heat transmission and vapor studies which have been published in the JOURNAL and TRANSACTIONS of the Society, and in the University of Minnesota Bulletins.

◆

Mario C. Giannini, New York, N. Y., associate professor of mechanical engineering and executive assistant of the College of Engineering, New York University, was born on January 15, 1902, in New York City, where he attended public schools. He later attended New York University, from which he received a B.S. degree in 1923 and his M.E. degree in 1926.

His first position was as draftsman and estimator for the A. Custodis Chimney Co., and in 1924 he joined the staff of Tenney and Ohmes Inc., as an engineer, remaining with this firm for seven years. In 1926 he became a member of the faculty of the New York University evening engineering division, and in 1931 accepted a full time position as a faculty lecturer in the day session of the College of Engineering. In addition to his present duties as associate professor at the University, Professor Giannini became a partner in the firm of Consulting Engineers Associated in 1934.

M. C. Giannini
New York, N. Y.

Since becoming a member of the ASHVE in 1935, Professor Giannini has been active in Society affairs. He is currently serving as chairman of the Special Society Committee to Cooperate with other Professional Societies and during the 52nd Annual Meeting he served as one of the vice chairmen of the Committee on Arrangements and as chairman of the Entertainment Committee. Early this year he was elected president of the New York Chapter. He served as its vice president during 1946 and as a member of its board of governors from 1944 to date.

In addition to the ASHVE, Professor Giannini holds memberships in the *American Society for Engineering Education,* is listed in *Who's Who in Engineering,* and is a member of Pi Tau Sigma. He is the author of several engineering articles and has served as a consultant to publishers on engineering and technical textbooks.

◆

F. W. Hutchinson, Berkeley, Calif., professor of mechanical engineering at the University of California, and consulting professor of mechanical engineering for Purdue University, was born April 7, 1910, in Suisan City, Calif. He attended the J.S.U. High School, Crockett, Calif., prior to entering the California Institute of Technology from which he was graduated in 1931 with a B.S. degree. He received his M.S. degree in 1937 from the University of California. In 1931 he accepted his first position with the C & H.S.R. Co., Crockett, Calif., as a construction inspector, and later was appointed mechanical engineer. He served as an associate professor of mechanical engineering at the University of California before joining the faculty of Purdue University, West Lafayette, Ind., as professor of mechanical engineering on July 1, 1945. His present appointment as a professor at the University of California was effective September 1, 1947. Professor Hutchinson is also consultant for several industrial firms.

An active member of the ASHVE, Professor Hutchinson joined the Society in 1937. In 1946 he was elected to serve a three-year term as a member of the Council and is now serving as a member of the Society's Membership Committee. In 1945 he was elected to serve a three-year term as a member of the Committee on Research and during this time he served on several Technical Advisory Committees including, Radiation and Comfort, Air Sterilization, and Physiological Research.

F. W. Hutchinson
Berkeley, Calif.

Professor Hutchinson is the author or co-author of numerous articles which have been published in various technical publications and in the JOURNAL and TRANSACTIONS of the Society. He is also a member of the *National Research Society*, the *ASRE, IAS*, Tau Beta Pi engineering fraternity, Sigma Xi and is listed in *Who's Who in Engineering*.

◆

Clarence W. Johnson, Windsor, Ontario, Canada, vice president, Canadian Sirocco Co., Ltd., was born on July 20, 1905, in Racine, Wis., where he attended public schools. He was graduated from the University of Wisconsin with a B.S. degree in 1927. Following graduation, he joined the American Blower Corp., Milwaukee, Wis., as a student engineer, and showed such aptitude during his course of training that he was transferred to the Chicago office as a sales engineer, later becoming manager of the Milwaukee office. In 1932 he was appointed Montreal district manager for the Canadian associate of the American Blower Corp., Canadian Sirocco Co., Ltd.

Mr. Johnson joined the ASHVE in 1931 and has been active in the affairs of the Montreal Chapter. He served as president of the Montreal Chapter during 1939-41, vice president during 1937-38, as secretary during 1935-37, and as a member of the board of governors during 1941 to 1944.

C. W. Johnson
Windsor, Ont., Canada

Mr. Johnson also holds membership in the *Professional Engineers of Quebec*, the *Professional Engineers of Ontario*, the Windsor Chamber of Commerce, the Rotary Club of Windsor, the Essex Golf and Country Club, and the Windsor Club.

◆

William E. Zieber, York, Pa., director of research, York Corp., was born on July 12, 1888 in Reading, Pa. He received his education in Reading public schools and later took an I.C.S. course in mechanical engineering.

His first positions consisted of apprentice work as a machinist in various shops in the vicinity of Reading, Pa. In 1912 he was engaged by the York Mfg. Co., York, Pa., as an erecting superintendent. Five years later he joined the staff of the Virginia Fruit Construction Co., Roanoke, Va., as chief engineer. In 1919 he left this position to join the Peoples Ice Co., Warren, Ohio, as chief engineer, and in 1921 he returned to the York Corp., as a research engineer. He was appointed mechanical engineer of this company in 1928, and assistant chief engineer in 1935.

A member of the Society since 1935, Mr. Zieber was elected to his first three-year term as a member of the Committee on Research in 1945, and he is now serving as a member of the Research Executive Committee. He served on many of its committees, including the TAC on Cooling Load which he served as a member in 1942 and as the chairman since 1943. In 1937 he served as a member of the ASHVE-*ASRE* Joint Committee on National Standards for Air Conditioning Applications.

W. E. Zieber
York, Pa.

Mr. Zieber is also a member of the *American Society of Refrigerating Engineers*, and is listed in *Who's Who in Engineering*.

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DONALD CASE IN NEW APPOINTMENT

Donald P. Case, a member of ASHVE, was recently appointed engineer with the MacCallum Steel Corp., Compton, Calif.

Prior to accepting his new position, Mr. Case had been employed as an engineer-estimator by W. C. Wiedenmann & Son, Kansas City, Mo. His duties with this firm included customer contact, estimating, layout, general sheet metal design, forced air heating, ventilating and blow pipe work.

He received his engineering education at Finaly Engineering College, graduating in 1942 with a mechanical engineering degree.

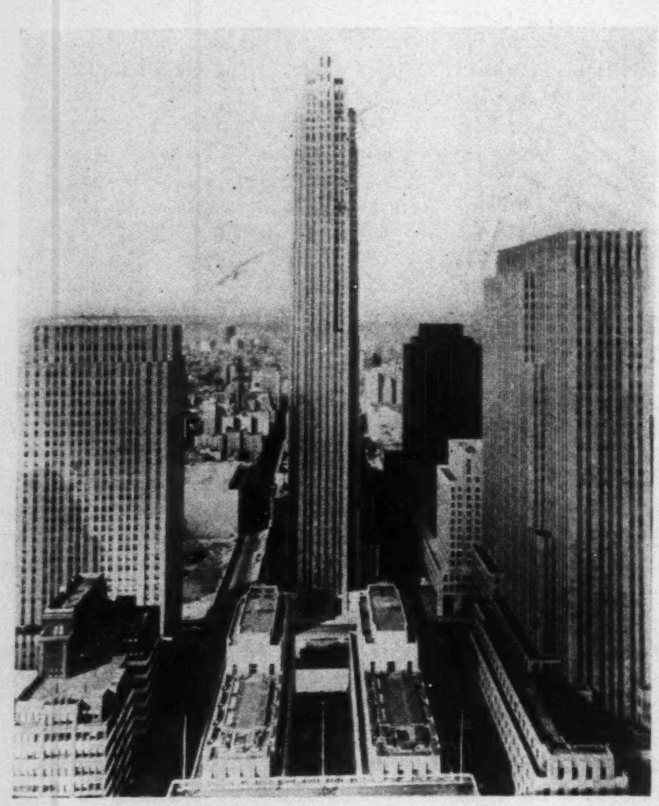
BIG ATTENDANCE AT SOCIETY'S 54th ANNUAL MEETING

February 1-5 1948

Hotel Commodore **New York, N. Y.**

PLANS for the 54th Annual Meeting of the Society are being developed rapidly by the Committee on Arrangements headed by Walter E. Heibel, general chairman. A warm welcome is being prepared for visiting members by the New York Chapter Committee in charge. A schedule of events has been prepared and the Meetings Committee has indicated that the opening session will be devoted largely to Society business and the reports of officers and committees. One of the important matters to be acted upon is the formal adoption of the new Constitution and By-Laws.

A Welcome Luncheon at noon on Monday will be held in the Grand Ballroom of the Hotel Commodore. A speaker with an interesting message for members is scheduled.



In the center is the 70-story RCA Building with La Maison Francaise (left) and the British Empire Building (right) at its base.

Rockefeller Center from the East

During the afternoon members will want to attend the opening of the 8th International Heating, Ventilating, and Air Conditioning Exposition at Grand Central Palace and the Entertainment Committee of New York Chapter will welcome all at a Hospitality Hour at 5:30 p.m.

Meeting

The Meetings Committee has planned five technical sessions and has selected a wide variety of subjects for presentation in order to cover the many interests of the members who will attend these sessions. The work of the Research Laboratory and its cooperating institutions will be featured in one of the sessions, and among the subjects to be offered for discussion are: Air Discharge from Long Slots; Friction Equivalents for Round, Square, and Rectangular Ducts; Measurement of Solar Heat Transmission; Air Filtration and Filter Testing Methods; Heat Pump Design and Operation, and Data on Climate.

When members are not attending sessions, they will find diversion in the program planned by the General Arrangements Committee of the New York Chapter. For those arriving early tickets will be provided for a variety of radio broadcasts. On Monday evening there will be a Hospitality Hour with special entertainment, and during the daylight hours the ladies will be enter-

The George Washington Bridge

tained in sightseeing, shopping, and other tours. Special announcement of these events will be made shortly and members will be invited to send in advance reservations for the special entertainment events and the annual banquet.

Exposition

The Exposition at Grand Central Palace will be open daily, Monday to Friday, and there is every indication that the announcement has stimulated nationwide interest in this event. Practically every inch of space on four floors of Grand Central Palace will be occupied by leading firms which provide the necessary equipment for heating, ventilating, and air conditioning of industrial, commercial, and residential buildings and there will be a comprehensive display depicting all methods of application and operation of the equipment that provides human comfort and aids in the production or processing of nearly all the products that are used in everyday life.

Advisory Committee

Heading the Exposition Advisory Committee is Dr. B. M. Woods, president of the Society, who is honorary chairman; A. J. Offner, past president of the Society, chairman; and A. E. Stacey, Jr., L. P. Saunders, C.-E. A. Winslow, M. C. Giannini, H. G. Strong, S. R. Osborne, R. H. Carpenter, and R. A. Wolff. The following officers of other organizations cooperating are: D. W. Orr, *AIA;* G. S. Armstrong, *AICE;* C. F. Holske, *ASRE;* J. M. Anderson, *HPACCNA;* J. V. Jones, *Insulation Board Institute;* R. E. Ferry, *I-B-R;* R. D. Martin, *NDHA;* R. S. Bohn, *Oil-Heat Institute of America;* P. K. Addams, *SBI;* T. J. Flanagan, *NAFM;* R. H. Nelson, *IUHA;* and F. S. McNeal, *ACRMA.*

For members who plan to attend the Society's meeting and the exposition, it is the suggestion of the local committee that they make early application for hotel rooms and arrange their transportation well in advance. The headquarters hotel and the other cooperating hotels in the Grand Central zone still have adequate housing facilities.

The week of February 1 will focus the attention of the nation on heat-

Schedule of Events

Sunday, February 1

10:00 a.m.	Committee Meetings
1:00 p.m.	Registration
2:00 p.m.	Meeting of the Council

Monday, February 2

8:30 a.m.	Registration
9:30 a.m.	Business Session Greetings Reports of Officers Reports of Council and Committees Constitution and By-Laws Report of Tellers of Election
12:15 p.m.	Welcome Luncheon
2:00 p.m.	Opening of 8th International Heating, Ventilating and Air Conditioning Expostion
2:30 p.m.	Meeting of Chapter Delegates
2:30 p.m.	Meeting of Committee on Research
5:30 p.m.	Hospitality Hour and Entertainment

Tuesday, February 3

9:30 a.m.	Technical Session — Air Distribution, Ventilation, and Comfort
2:00 p.m.	Technical Session—Panel Heating and Solar Radiation
4:00 p.m.	Organization Meeting of 1948 Committee on Research
6:30 p.m.	Past Presidents' Dinner

Wednesday, February 4

9:30 a.m.	Technical Session—Heating and Air Conditioning
2:00 p.m.	Symposium — The Heat Pump for Year Round Air Conditioning
7:00 p.m.	Annual Banquet

Thursday, February 5

10:00 a.m.	Technical Session—Heating and Air Conditioning Resolutions Installation of Officers
1:00 p.m.	Organization Meeting of Council

ing, ventilating, and air conditioning.

Arrangements Committee

The Committee in Charge is:

Banquet—W. A. Swain, *chairman;* H. H. Bond, J. W. Booker, F. D. Lawrence, R. M. Nee, F. V. Self, B. F. Thomas, Jr.

Entertainment—Harold J. Rose, *chairman;* A. A. Bearman, J. C. Fitts, A. F. Hinrichsen, F. D. McCann, G. E. Olsen.

Exposition—C. F. Roth, *chairman.*

Finance—W. M. Heebner, *chairman;* H. W. Fiedler, *vice chairman.*

Ladies—H. S. Wheller, *chairman;* Mr. and Mrs. G. C. Cummings, Mr. and Mrs. H. B. Eells, Mrs. G. D. Fyfe, Mr. and Mrs. F. D. Lawrence, Mr. and Mrs. T. R. Peyrek, Mr. and Mrs. C. H. Smith, Mr. and Mrs. F. J. Swaney, Mr. and Mrs. A. G. Syska, Mr. and Mrs. W. G. W. Turno, Mrs. H. S. Wheller.

Publicity—Clifford Strock, *chairman;* W. J. Osborn.

Reception—M. C. Giannini, *chairman;* W. A. Sherbrooke, *vice chairman;* P. D. Bemis, H. H. Bond, A. C. Buensod, V. J. Cucci, H. B. Hedges, C. S. Koehler, L. L. Munier, O. O. Oaks, S. R. Osborne, C. S. Pabst, E. J. Ritchie, Winfield Roeder, H. J. Ryan, Joe Wheeler, Jr.

Sessions—H. S. Birkett, *chairman;* L. D. Angell, S. R. Apt, G. C. Cummings, Albert Giannini, C. W. Hartmann, Harry Hartmann, H. J. MacKay, J. D. W. Robertson, J. E. Schechter, J. G. Skidmore.

Secretary—Carl H. Flink.

Committee on Panel Heating and Cooling

Members of the group on Heat Transfer Within and Behind the Panel, one of four such elements composing the Technical Advisory Committee on Panel Heating and Cooling, met at the ASHVE Research Laboratory in Cleveland, Ohio, on November 5.

Conferences of the day were called to consider a suggested program and to make recommendations to the Society's Committee on Research for the studies in panel heating to be activated at the Research Laboratory.

The Committee meeting in Cleveland was one of four such groups, each of which was established to cover a specific phase of the research program.

L. N. Hunter, vice president, The National Radiator Co., Johnstown, Pa., is chairman of the Committee. P. B. Gordon, vice chairman, is treasurer of Wolff and Munier, Inc., New York City. Members of the Committee include: Prof. A. B. Algren, University of Minnesota, Minneapolis, Minn.; R. A. Biggs, Pittsburgh Corning Corp., Pittsburgh, Pa.; Wharton Clay, secretary, *National Mineral Wool Association,* New York City; R. S. Dill, National Bureau of Standards, Washington, D.C.; H. L. Flodin, *Portland Cement Association,* Chicago, Ill.; Dr. F. E. Giesecke, consulting engineer, New Braunfels, Tex.; Prof. W. S. Harris, University of Illinois, Urbana, Ill.; Prof. C. F. Kayan, Columbia University, New York City; G. D. Lain, American Iron and Steel Institute, New York City; D. L. Mills, Revere Copper and Brass, Inc., Rome, N. Y.; C. W. Nessell, *National Warm Air Heating and Air Conditioning Association,* Cleveland, Ohio; P. S. Park, A. M. Byers Co., Pittsburgh, Pa.; S. I. Rottmayer, Samuel R. Lewis and Associates, Chicago, Ill.; S. M. Van Kirk, technical secretary, Insulation Board Institute, Chicago, Ill.; J. R. Willard, Aluminum Company of America; and L. H. Yeager, general manager, *Gypsum Association,* Chicago, Ill.

Meetings of the other three Committees will be held at future dates.

The second group will relate its considerations to Heat Transfer Between the Panel and the Space. John James, research engineer, Iron Fireman Mfg. Co., Cleveland, Ohio, is chairman. H. F. Randolph, vice president, International Heater Co., Utica, N. Y., is vice chairman. The remainder of this Committee consists of: C. M. Ashley, Carrier Corp., Syracuse, N. Y.; J. T. Bergen, Armstrong Cork Co., Lancaster, Pa.; C. F. Boester, Purdue Research Foundation, West Lafayette, Ind.; Prof. Linn Helander, Kansas State College, Manhattan, Kans.; A. L. Jaros, Jr., Jaros, Baum & Bolles, New York City; H. A. Lockhart, Bell and Gossett Co., Morton Grove, Ill.; Prof. C. O. Mackey, Cornell University, Ithaca, N. Y.; R. A. Miller, Pittsburgh Plate Glass Co., Pittsburgh, Pa.; Prof. G. W. Penney, Carnegie Institute of Technology, Pittsburgh, Pa.; G. G. Sward, *National Paint, Varnish and Lacquer Association,* Washington, D.C.; and J. M. van Nieukerken, *Copper and Brass Research Association,* New York City.

The third group, which will deal with Controls for Panel Heating, includes as chairman J. S. Locke, sales manager, Air Conditioning Controls Div., Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. Its vice chairman is Prof. A. B. Algren, professor of heating, ventilating and air conditioning, University of Minnesota, Minneapolis, Minn. Committee members are: H. W. Alyea, Johnson Service Co., Milwaukee, Wis.; S. D. Browne, Barber-Colman Co., Rockford, Ill.; P. B. Gordon, Wolff and Munier, Inc., New York City; W. J. Hajek, Fulton Sylphon Co., Knoxville, Tenn.; A. J. Keating, Powers Regulator Co., Chicago, Ill.; Dr. Waldo Kliever, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.; H. T. Kucera, Automatic Devices Co., Chicago, Ill.; E. J. Ritchie, Sarco Co., New York City; N. D. Skinner, Hoffman Specialty Co., Inc., Indianapolis, Ind.; and J. K. M. Pryke, Slocum and Fuller, New York City.

Physiological aspects of the problem will be considered by yet a fourth element, the membership of which is to be announced.

S. C. STEIN APPOINTED RESEARCH ENGINEER

According to a recent announcement, S. C. Stein has joined the Viking Air Conditioning Corp., Cleveland, Ohio, research staff as a research engineer.

A graduate of New York University with a B. S. degree in mechanical engineering, Mr. Stein received his M. S. degree from the University of Illinois, where his principal activities centered around the development of the furnace blower research project. Mr. Stein joined the ASHVE in 1947, and is a student member of the *ASME.*

Summary of Local Chapter Meetings*

ATLANTA—October 3, 1947. Subject: Psychology. Speaker: F. C. McIntosh, branch manager, Johnson Service Co., Pittsburgh, Pa. Members enjoyed Mr. McIntosh's interesting and informative talk and the discussion period which followed. Attendance 33.

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CONNECTICUT—September 26, 1947. Subject: Inspection Trip of Wind Tunnel, Pratt & Whitney Division, United Aircraft, East Hartford, Conn. In connection with the inspection of the wind tunnel, Henry Hoadley, research engineer of the Pratt & Whitney Division, presented some interesting information in regard to work carried on by his department, particularly in regard to the designing of the wind tunnel. Other Features: The chairman of the meetings committee, C. L. L'Hommedieu, gave a report on the programs planned for future meetings and E. R. Clement, acting for the membership committee, introduced new members. President Osborne announced that the 54th Annual Meeting of the ASHVE would be held in New York, N. Y., Feb. 1-5, 1948. S. R. Osborne, P. D. Bemis, and Winfield Roeder were appointed to serve on the Reception Committee in accordance with an invitation from the New York Chapter, which is making the arrangements for the Annual Meeting. Attendance 61. Attendance ratio 0.32.

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DELTA—October 14, 1947. Subject: Experiences in a Wind Tunnel. Speaker: James Adair, owner, James S. Adair, New Orleans, La. A discussion period followed Mr. Adair's stimulating talk. Other Features: A motion picture entitled *Louisiana* was shown and enjoyed. John Burke was elected delegate to the Society's Annual Meeting, with L. R. Maxwell serving as alternate. A discussion on the Annual Meeting was held and it was decided that a questionnaire be sent to all members in regard to holding a future society meeting in New Orleans. Attendance 36.

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DELTA—September 9, 1947. Subject: Film, *The Making and Shaping of Steel*. Members greatly enjoyed films describing the manufacture of steel, which were shown by Fritz Kresnecht. Other Features: Chairmen of the different committees were introduced and Walter Cook spoke on the necessity of checking into building code conditions. Ralph Rothrock extended an invitation to all chapter members to attend a stag party to be held at his residence and mention was made of a boat ride to be held at the end of September. Attendance 33.

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GOLDEN GATE— October 2, 1947. Subject: Industrial Dust Control. Speaker: R. H. Walpole, American Air Filter Co. In his excellent talk, Mr. Walpole defined dust, and discussed methods for its control. After emphasizing the importance of proper hood design, he showed slides indicating several varieties of hooding. He also mentioned the California State laws affecting dust control, and discussed wet and dry collectors, and selection of equipment. A lively discussion period followed. Other Features: New amendments to the Chapter's constitution and by-laws were passed, and the Pacific Chemical Exposition was announced. Attendance 40.

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ILLINOIS—October 13, 1947. Subject: Industrial Panel Heating. Speaker: H. A. Lockhart, chief engineer, Bell & Gossett Co., Morton Grove, Ill. Mr. Lockhart thoroughly covered the applications of floor or ceiling panels and the advantages of each. He also covered the application of copper and ferrous tubing and discussed control methods. He stated that an installation of a radiant heating system has resulted, according to his experience, in a reduction in absenteeism and improved attitude of workmen. Attendance 156. Attendance Ratio 0.41.

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INDIANA—September 26, 1947. Subject: Panel Heating. Speaker: Prof. W. T. Miller, Purdue University, Lafayette, Ind. Professor Miller stressed the fact that every panel heating installation should be carefully engineered, since a poorly engineered panel heating job might work, but many would not prove satisfactory. A discussion period followed Professor Miller's interesting talk. Other Features: President Cotton announced the election of C. R. Ammerman to Life Membership in the Society and introduced the other Life Members, S. E. Fenstermaker, Sr., and J. G. Hayes, who were present. Attendance 78.

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IOWA—October 14, 1947. Subject: Panel Discussion on Combustion. Moderator: C. H. McGuinness. Speakers: Perry LaRue, director, buildings and grounds department, Independent School District; P. C. DeHaan, gas division, Iowa Power and Light Co.; W. W. Stuart, owner, Stuart Supply Co., and Roger Booth, chief engineer, Lennox Furnace Co. Mr. LaRue spoke on combustion of coal with emphasis on requirements in fire box design to properly handle Iowa or other low Btu coal. Mr. DeHaan gave combustion requirements for the burning of natural gas with the emphasis on proper control and throttling of fuel and air supply. A talk on combustion requirements for fuel oil was given by Mr. Stuart. Mr. Booth reported on a mercury vapor heating system as developed by Dr. Lucas. Other Features: The membership committee was appointed by Pres. C. A. Wheeler, and chapter delegates for the 1947-48 season were elected as follows: C. A. Wheeler, delegate and D. C. Murphy alternate. Attendance 25.

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*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

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Kansas City—October 6, 1947. Subject: Reverse Cycle Refrigeration. Speaker: Carl F. Boester, housing research executive, Purdue Research Foundation, Purdue University, Lafayette, Ind. Mr. Boester spoke on reverse cycle refrigeration especially as applied to small homes, and also mentioned some aspects of radiant heating. Slides were used by the speaker to illustrate the installation made in an all aluminum test house at Purdue University. An active discussion period followed, from which it was apparent that everyone enjoyed Mr. Boester's presentation. Other features: The treasurer's report was given by Kenneth Stevens, and Leon Mart reported on his trip to the summer meeting at Coronado, Calif. Attendance 77.

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Massachusetts—October 27, 1947. Subject Radiant Heating. Speaker: R. G. Vanderweil, associate, Slocum and Fuller, New York, N. Y. Mr. Vanderweil's interesting and informative presentation was enjoyed by members. Attendance 79. Attendance ratio 0.95.

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Memphis—September 15, 1947. Subject: Uses of the Psychrometric Chart. Speaker: W. E. Thorpe, mechanical engineer, Hanker & Heyer, architects. Mr. Thorpe discussed the Carrier and Hill charts and their application to heating and cooling calculations. The second in a series of talks given by a member of the Memphis Chapter, Mr. Thorpe's talk proved of interest to his audience. Other Features: A letter from the Secretary of the Society concerning the By-Laws was read and a motion was carried that E. E. Scott be elected delegate to the Annual Meeting in February. Attendance 22. Attendance ratio 0.55.

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Michigan—October 13, 1947. Subject: Radiant Heating, Cooling, and Snow Melting Applications. Speaker: T. Napier Adlam, technical director, Sarco Controls, Inc., New York, N. Y. Adlam started his interesting talk with a survey of early installations of radiant heat with which he had been connected in England and continued with a discussion of later, more modern jobs and practices in this country. A lively discussion period followed. Other Features: The reports of the various committees were heard and F. R. Bishop, past president, reported on the Chapter Relations Committee meeting held during the Semi-Annual Meeting, Coronado, Calif. Attendance 155.

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Minnesota—October 6, 1947. Subject: Engineering Approach to Panel Cooling. Speaker: C. S. Leopold, consulting engineer, Philadelphia, Pa. Mr. Leopold ably presented several new phases and problems of panel cooling. A lively discussion period followed. Other Features: Pres. L. C. Gross extended a cordial welcome to guests, among whom were 25 members of the Twin City Society of the *ASRE*. Members and guests enjoyed an interesting sound film which was presented by the entertainment committee. Attendance 142.

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Nebraska—October 14, 1947. Subject: Panel Heating for Homes. Speaker: Carl F. Boester, housing research executive, Purdue Research Foundation, Purdue University, Lafayette, Ind. Mr. Boester in addition to panel heating, also spoke briefly on the heat pump. Pictures of piping arrangements in the ground to remove the heat were shown. Various questions on initial costs, operating expense, etc., were asked by the members. Other Features: President Simmonds announced that a nominating committee would be elected at the next meeting. Attendance 40.

•

New York—October 20, 1947. Subject: When and How to Select the Axial Flow Fan. Speaker: W. R. Heath, assistant chief engineer, Buffalo Forge Co., Buffalo, N. Y. Mr. Heath referred to the history of the axial flow fan, described the characteristics of this type of fan, and compared its advantages and disadvantages. A series of slides was used to demonstrate the design characteristics of fans and to show standard equipment and applications in industry. Following the presentation, Mr. Heath answered questions on axial and centrifugal fan performance and application, after which he was given a rising vote of thanks. Other Features: A Society member from India, B. B. Ghosh, spoke briefly on the food preservation plans of the Government of India, of which he is deputy director of engineering. C. S. Koehler, membership committee chairman, gave a brief report of plans for increasing membership. W. E. Heibel, chairman of the Committee on Arrangements for the Society's 54th Annual Meeting to be held in New York, February 1-5, 1948, reported on preparations that are being made for the meeting. Attendance 125. Attendance ratio 0.60.

•

North Texas—October 19, 1947. Subject: Films and Talk on the Steam Power Industry. Speaker: David C. Pfeiffer, professor of mechanical engineering, Southern Methodist University, Dallas, Tex. The first film shown was *There is an Engineering Reason,* courtesy of Yarnall-Waring Co., which explained the use and application of various steam specialties, valves, traps and temperature controllers. The second film entitled *Steam Power for Our Sea Power,* produced by the Babcock & Wilcox Co., illustrated the various types of boilers as manufactured for our Navy and the unique methods employed in manufacturing and assembling high pressure steam power plants as used in our naval vessels. Mr. Pfeiffer delivered a brief address on the steam power industry as a whole and related the great strides made over the period of the last twenty years, which he attributed to this country's prominence in the metallurgical field, the development of new materials, and the use of engineering forethought in design practices. Other Features: A discussion was held on the 54th Annual Meeting and the possibility of holding some future Annual Meeting in Dallas, Tex. Attendance 56.

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Northern Ohio—October 13, 1947. Subject: The Natural Gas Situation in the United States. Speaker: Carl Emmerling, sales manager, East Ohio Gas Co. Mr. Emmerling pointed out that while the rate of discovery of gas fields is approximately 2½ times the rate of its use, there is a shortage of gas due to inadequate transportation facilities between the gas fields and the consumer areas. The increased demand for gas, due to its stable cost in comparison with the rising cost of other fuels, has resulted in a ban by various public utilities commissions and a number of utilities themselves on further installations of gas burning apparatus for heating. At the conclusion of Mr. Emmerling's interesting talk, a color movie was shown of the construction of a gas line from Corpus Christi to West Virginia, which was built in one year during the war. Other Features: A brief coffee talk covering some of the paradoxical situations which our government has faced in fitting a foreign policy to its domestic policy was given by Robert Dearth, of the Council on World Affairs. Several committee reports were given and D. L. Taze, a member of the Program Coordinating Committee of the Cleveland Technical Societies Council, reported on a general meeting of the Council on City Planning. J. E. Wilhelm reported on the progress of the new city code as it affects the installation of heating, ventilating air conditioning and refrigeration systems. Messrs. Tasker and Moore, in reporting on the fund to reduce the mortgage on the Research Laboratory, stated that the Northern Ohio Chapter has exceeded its quota by better than 100 percent.

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Ontario—October 6, 1947. Subject: Selection of Insulation and Its Application. Speaker: G. D. Lortz, Philip Carey Mfg. Co., Cincinnati, Ohio. Members and their guests greatly enjoyed Mr. Lortz's informative talk. Other Features: An invitation was extended to members to attend an Affiliated Engineering Societies of Ontario dance, to be held in November. Attendance 79. Attendance ratio 0.45.

•

Oregon—October 9, 1947. Subject: The Heat Pump. Speaker: R. C. Chewning, treasurer, Oregon Chapter. Mr. Chewning's talk covered the heat pump and other mechanical features installed in the new Equitable Office Building, Portland, Ore. Other Features: After the members of the nominating committee were elected, Mr. Chewning, as treasurer, reported on the collection of dues. A report on types of member identification badges available was given by W. R. Norte and a discussion was held on orders for ASHVE pins. A suggestion was made and approved that a joint meeting be held with the Pacific Northwest Chapter. A vote of confidence was extended by the chapter to Walter Hawthorn, who had been delegated by the city of Portland to draw up a new warm air heating code. Attendance 144. Attendance ratio 0.6.

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Philadelphia—October 9, 1947. Subject: Engineered Air Distribution. Speaker: V. M. Lathers, Barber-Colman Co., Rockford, Ill. At the close of Mr. Lathers' informative talk, a discussion period was held. Other Features: Both H. L. Roberts, and Lee Nusbaum, who were elected to Life Membership, gave short talks, reminiscent of the founding of the Chapter in 1915-16. The treasurer's report was read and approved. Attendance 131.

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Pittsburgh—October 13, 1947. Seeing Ourselves as Others See Us. Speaker: A. W. Leonard, president, Leonard Personnel Services. Mr. Leonard, in the course of his work, has interviewed hundreds of men of all types every month. He stated that there are 28 different personal traits, and discussed the different traits which a man looking for a position should watch. Mr. Leonard's informative topic was enjoyed by members. Other Features: B. B. Reilly reported on Chapter finances, and T. F. Rockwell spoke on the Guide Publication Committee, with reference to work that must be done on the air conditioning section of The Guide. Attendance 55. Attendance ratio 0.54.

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Rocky Mountain—October 8, 1947. Subject: Reverse Cycle Refrigeration and Panel Heating in Small Residences. Speaker: Carl F. Boester, housing research executive, Purdue Research Foundation, Purdue University, Lafayette, Ind. Members enjoyed Mr. Boester's informative talk. Other Features: Pres. J. F. Mohan announced that the next meeting would be a social meeting to which the ladies would be invited. Appointments to the various committees were announced and members from the previous season's Code and Legislative Committees were asked to continue the work which they had started. Attendance 38.

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St. Louis—October 15, 1947. Subject: Processing and Storage Plants for Frozen Foods. Speaker: J. H. Carter, president, St. Louis Chapter and partner, Bodine & Carter, Webster Groves, Mo. Mr. Carter covered the development of frozen food lockers in Illinois. He discussed the financing of the lockers and the design, construction, comparative and operating costs of buildings. Mr. Carter enlarged on the design of buildings, by passing a blue print copy of a typical plant to members, showing the importance of the various processing areas. He also mentioned the advantages and disadvantages of ammonia and "Freon" refrigerants. An enthusiastic question and answer period followed and a rising vote of appreciation was accorded to Mr. Carter. Other Features: Committee reports were heard and it was announced that the next meeting would be a joint meeting with the Engineer's Club and the *ASRE*. Attendance 51.

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South Texas—September 19, 1947. Subject: Air Conditioning Problems. Speaker: Robert Salinger, chief engineer, R. F. Taylor, consulting engineer, Houston, Tex. Mr. Salinger discussed air conditioning problems under three classifications; engineering design, manufacturer's equipment ratings and ability to meet ratings, and installation from the standpoint of workmen's ability to execute designs of systems. Many of the members took part in the active discussion period which followed Mr. Salinger's excellent talk. Other Features: Committee reports were given, after which Pres. D. M. Mills announced that L. L. Ladewig was chosen alternate and C. C. Quin delegate, to the 54th Annual Meeting, New York, N.Y., February, 1948. G. H. Jackson, President of the Texas A. and M. College Student Branch, reported on the activities of the student branch. Attendance 95.

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South Texas—September 8, 1947. A special meeting was called by Pres. D. M. Mills at which the delegate and alternate to the forthcoming Annual Meeting were chosen. Notification of those selected to act as delegate and alternate was sent to the National Society headquarters, and an additional contribution to the fund to reduce the Research Laboratory mortgage was also sent. A speaker for the next chapter meeting was chosen and committee activities were discussed. Attendance 9.

•

South Texas—August 22, 1947. Social Meeting and Get-Together. Coach Cecil Grigg of Rice Institute gave a short talk on the sports activities of the college and also gave the narration for an eight reel movie film which was shown. All regular business was dispensed with. Attendance 30.

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Southwest Texas—October 21, 1947. Subject: Water Treatment. Speaker: C. E. Beauchamp, Metropolitan Refining Co., Inc., New York. Mr. Beauchamp discussed water treatment from the standpoint of cooling towers and evaporative condensers in general. Problems of a general nature were covered in the discussion period which followed Mr. Beauchamp's excellent talk. Attendance 31.

•

Southwest Texas—May 20, 1947. Subject: Demonstration and Lecture on Submerged Combustion. Speaker: Prof. K. A. Kobe, University of Texas, Austin, Tex. Professor Kobe presented the uses, values and limitations of submerged combustion. In explaining his subject Professor Kobe used a laboratory apparatus consisting of a large glass jar containing approximately ten gallons of clear water, a compressor set to compress both natural gas and air, and a special burner experimentally produced by Professor Kobe for under water burning of the air-gas mixture. The meeting was thrown open to discussion and several of the members tried their skill at using the demonstration apparatus to maintain combustion under water. Attendance 33.

•

Southwest Texas—April 17, 1947. Subject: Radiant Panel Heating and Solar Heating. Speaker: Prof. F. W. Hutchinson, Purdue University, Lafayette, Ind. Professor Hutchinson's interesting talk was illustrated with slides. Many members took part in the discussion period which followed. Attendance 31.

•

Western Michigan—September 2, 1947. Subject: General Business Meeting. President Frank Harbin presented for approval his appointments for the various committees. Secretary DeRoo was instructed to have a 1947-48 roster printed listing the members of the chapter, contributor guests, committee appointments and place of meetings. Each member is to receive a copy by mail. A motion was approved to purchase identification badges for members and visitors. Arrangements were made for the filing of the different chapter records, and a suggestion was made that joint meetings with other societies be held occasionally.

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Wisconsin—October 20, 1947. Subject: Aluminum Ducts. Speaker: Joseph Wilder, executive secretary, Sheet Metal Contractors National Association. Mr. Wilder discussed the subject of aluminum ducts from the engineer's point of view. Such items as the proper gages, types of aluminum, joints, and hangers which should be used, and the use of some machinery in fabricating aluminum ducts were covered in detail. Some of the problems of corrosion were also discussed, along with the work which the aluminum companies are doing to assist contractors in doing a good job with aluminum. A lively discussion period followed and a rising vote of thanks was accorded the speaker. Other Features: The secretary announced that the directory listing members of the chapter would be available soon. A. H. Krenz advised that many students from nearby colleges were seeking positions and asked members with technical positions available to contact him. Attendance 57.

Student Branch

Texas A. & M.—Subject: History of the ASHVE and Air Conditioning. Speaker: J. S. Hopper, assistant to the dean of engineering, A. M. College of Texas. After speaking about the history of the society and of air conditioning, Mr. Hopper made recommendations for the promotion and advancement of the Texas A. & M. Student Branch. W. E. Long also made some comments on the benefits and operations of the student branch. Other Features. W. E. Long, J. S. Hopper and W. E. Rohrabacher were elected to the *board of governors*. Attendance 25.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 84 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by December 20, 1947, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

AUGUSTERFER, RAYMOND J., Vice-Pres., Ambrose-Augusterfer Corp. **PROPOSERS:** F. H. Buzzard, M. E. Barnard. **SECONDERS:** R. H. Ackerman, E. H. Dafter.

BAKER, JOHN T., Engr., Magney, Tusler & Setter. **PROPOSERS:** L. C. Gross, A. B. Algren. **SECONDERS:** J. E. Haines, J. S. Locke.

BARNARD, WILLIAM B., Student, Purdue University. **PROPOSERS:** W. T. Miller, C. F. Warner. **SECONDERS:** H. Clark*, H. G. Venemann*.

BLOJ, CARLOS, Sociedad Industrial Electer. **PROPOSERS:** H. H. Koster, J. W. Booker. **SECONDERS:** J. J. Jacobs, Jr.*, L. Q. H. Chin*.

BOKMAN, THOMAS P., Engr., Westinghouse Elec. Corp. **PROPOSERS:** F. C. McIntosh, H. H. Thayer. **SECONDERS:** H. A. d'O. Saurbrey*, N. A. Christiano*.

BOLIN, HAROLD W., Student, David Ranken Jr. School of Mech. Trades. **PROPOSERS:** J. T. Lynch, G. B. Rodenheiser. **SECONDERS:** W. A. Russell, E. Clucas.

BOTTORF, JAMES D., Student, Purdue University. **PROPOSERS:** C. F. Warner, W. T. Miller. **SECONDERS:** G. A. Hawkins*, Y. S. Touloukian.

BROWN, CLINTON H., Sales Engr., Desco Corp. **PROPOSERS:** H. E. Grossman, C. J. Lubking. **SECONDERS:** A. H. Koch, F. H. Buzzard.

CAMPBELL, ROGER P., Branch Mgr., E. K. Campbell Co. *(Advancement)* **PROPOSERS:** E. K. Campbell, D. M. Allen. **SECONDERS:** Ray Mason, Kirk Campbell.

CARNAHAN, JOHN H., Chief Mech. Engr., Coston and Frankfurt. **PROPOSERS:** W. W. Frankfurt, E. W. Gray. **SECONDERS:** R. G. Dolan, C. J. Maupin*.

COLLINS, DESMOND M., Bldg. Serv. Engr., Stone & Webster Engineering Corp. **PROPOSERS:** E. R. Blair, H. S. Cole. **SECONDERS:** D. W. Blair, J. W. Brinton.

COLLINS, JEROME, Student, Purdue University. **PROPOSERS:** W. T. Miller, Y. S. Touloukian. **SECONDERS:** H. G. Venemann*, A. N. Spalding*.

CONNORS, FRANCIS E., Student, David Ranken Jr. School of Mech. Trades. **PROPOSERS:** J. T. Lynch, G. B. Rodenheiser. **SECONDERS:** W. A. Russell, E. Clucas.

COX, ROBERT G., Mech. Engr., R. K. Werner, Cons. Engr. **PROPOSERS:** R. G. Lyford, M. A. Benson. **SECONDERS:** R. A. Grimmer, C. R. Gardner.

CROCKER, CHARLES G., Engr., United Gas Corp. **PROPOSERS:** A. E. Workman, C. A. McKinney. **SECONDERS:** D. M. Mills, W. J. Way.

DIAS, WILLIAM B., Owens-Corning Fiberglas Corp. **PROPOSERS:** W. E. Heibel, W. L. Fleisher. **SECONDERS:** J. H. Waggoner, G. D. Fife.

DULL, WILLIAM M., Htg. Engr., The Detroit Edison Co. **PROPOSERS:** G. D. Winans, G. H. Tuttle. **SECONDERS:** E. E. Dubry, C. F. Donohoe.

EID, ABDALLAH KAMEL, Graduate Student, Michigan State College. **PROPOSERS:** L. G. Miller, C. H. Pesterfield. **SECONDERS:** D. J. Renwick*, J. T. Anderson.

FLANIGAN, WILLIAM P., Vice Pres., Lloyd E. Mitchell, Inc. **PROPOSERS:** E. L. Crosby, H. D. Glaser. **SECONDERS:** E. H. Taze, E. R. Queer.

GAGLIARDI, FRANK A., Graduate Student & Instructor, University of Florida. **PROPOSERS:** N. C. Ebaugh*, S. P. Goethe. **SECONDERS:** J. T. Leggett*, W. J. McKinney.

GLASER, HARRY D., Engr. & Secy., Henry Adams, Inc. *(Advancement)* **PROPOSERS:** E. L. Crosby, E. H. Taze. **SECONDERS:** P. J. Vincent, R. L. Leilich.

GOTH, CARL A., Mech. Engr., Corps. of Engineers. **PROPOSERS:** V. Simmonds, O. J. Smith. **SECONDERS:** C. A. Carter, B. G. Peterson.

GOWDY, ALLEN C., Mgr. & Engr., The Huffman-Wolfe Co. **PROPOSERS:** L. Sudderth, Jr., W. J. McKinney. **SECONDERS:** W. W. Carder, H. K. McCain.

GREGORY, ROBERT C., JR., Prov. Engr., Rayon Consultants, Inc. **PROPOSERS:** W. R. Norman*, H. C. Reh. **SECONDERS:** G. A. Prochazka, Jr.*, J. J. Fetscher.

HENDRIX, WILLIAM T., Member of firm, Wolf & Hahn. **PROPOSERS:** I. F. LeGrand, W. A. Bornemann. **SECONDERS:** M. E. Barnard, L. M. Church.

HORNE, EDWIN C., Mfrs. Repr., H. Marcus Co. **PROPOSERS:** J. L. McCann, H. E. Park. **SECONDERS:** L. S. Walker, R. J. Doherty.

HUEBSCHER, RICHARD G., Research Engr., ASHVE Research Laboratory. **PROPOSERS:** Cyril Tasker, G. V. Parmelee. **SECONDERS:** C. M. Humphreys, Samuel Ward*.

JAMES, REX P., Sales Engr., York Corp. **PROPOSERS:** E. R. Sitton, H. W. Broadwell. **SECONDERS:** R. S. Sandifer, E. H. McLane.

JAMES, RICHARD G., Student, Purdue University. **PROPOSERS:** W. T. Miller, F. W. Hutchinson. **SECONDERS:** A. C. Menke, H. G. Venemann*.

JAMIESON, JOHN R., JR., Student, University of Minnesota. **PROPOSERS:** A. B. Algren, R. C. Jordan. **SECONDERS:** C. E. Gausman, William Sturm.

JUNG, HOWARD G., The Zack Co. **PROPOSERS:** H. J. Zack, W. A. Kuechenberg. **SECONDERS:** M. J. Bamond, G. W. Bornquist.

KANE, MARSHALL E., Student, David Ranken Jr. School of Mech. Trades. **PROPOSERS:** J. T. Lynch, G. B. Rodenheiser. **SECONDERS:** W. A. Russell, E. Clucas.

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*Non-Member

Kaufman, Arnold M., Sales Engr., Harry H. Marcus Co. Proposers: J. L. McCann, H. E. Park. Seconders: L. S. Walker, R. J. Doherty.

Knecht, Andrew W., Asst. Chief Engr., Walter Kidde Constructors, Inc. Proposers: F. D. Lawrence, R. I. Stinard. Seconders: A. F. Hinrichsen, C. W. Hartmann.

Ladewig, Fred K., Sales Engr., The Trane Co. Proposers: Henry Nottberg, Jr., R. F. How. Seconders: Gustav Nottberg, Louis Izard.

Lee, Marvin N. T., Student, University of Minnesota. Proposers: A. B. Algren, R. C. Jordan. Seconders: C. E. Gausman, William Sturm.

Litwack, Herman E., Anderson & Litwack. Proposers: H. E. Anderson, M. J. Bamond. Seconders: A. H. Blaker, G. W. Bornquist.

Loseman, John L., Student, David Ranken Jr. School of Mech. Trades. Proposers: J. T. Lynch, G. B. Rodenheiser. Seconders: W. A. Russell, E. Clucas.

McKenzie, Hilton E., Field Service Engr., A. M. Byers Co. Proposers: J. A. Cain, C. Z. Adams. Seconders: M. F. DuChateau, P. L. Guest, Jr.

Mathis, Luther N., L. N. Mathis Htg. & Air Cond. Co. Proposers: R. W. Barnes, F. C. Benham. Seconders: R. W. Kotzebue, A. J. Rummel.

Montgomery, Foster W., J. A. Walsh & Co. Proposers: C. L. Boehler, J. A. Walsh. Seconders: C. W. Ellis, W. C. Laughlin.

Montgomery, Thomas F., Student, Purdue University. Proposers: W. T. Miller, C. F. Warner. Seconders: H. G. Venemann*, A. N. Spalding*.

Nash, Bruce T., Engr., Dick & Kirkman, Inc. Proposers: M. F. DuChateau, C. D. Hartsfield. Seconders: W. D. Graham, P. L. Guest.

Nelson, Franklin L., Student, David Ranken Jr. School of Mech. Trades. Proposers: J. T. Lynch, G. B. Rodenheiser. Seconders: W. A. Russell, E. T. Clucas.

Norris, Camden G., Partner, Dill & Norris Sheet Metal & Htg. Co. Proposers: B. V. Simons, G. B. Rodenheiser. Seconders: W. A. Russell, E. Clucas.

Nutting, Robert E., Supt., Jaden and Dutton-Lainson Mfg. Cos. Proposers: H. A. Lainson, Jr., C. B. Bernstrom. Seconders: Dr. F. E. Weyer, A. S. Reiff.

Olivieri, Joseph B., Student, University of Detroit. Proposers: E. F. Hyde, J. J. Uicker. Seconders: D. C. Hunt*, L. R. Blakeslee*.

Osborn, Francis W., Sales Engr., Minneapolis-Honeywell Regulator Co. Proposers: F. W. McCarthy, E. O. Olson. Seconders: R. S. Stover, D. E. Wells.

Ownby, Robert W., Student, David Ranken Jr. School of Mech. Trades. Proposers: J. T. Lynch, G. B. Rodenheiser. Seconders: W. A. Russell, E. Clucas.

Parodi, H., Cons. Engr., Syndicat National de la Construction Electrique. Proposers: A. Beaurrienne, A. Nessi*. Seconders: A. Desplanches, R. C. Goenaga*.

Pattiz, Gene B., Engr., General Installation Co. Proposers: E. T. Clucas, L. Gross. Seconders: B. V. Simons, W. A. Russell.

Pinkham, Jesse R., Sales Engr., Delco Appliance Div., General Motors Corp. Proposers: C. E. McCallum, A. Z. Price. Seconders: L. L. Vaughan, R. B. Rice.

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Witte, George C., Jr., Student, Purdue University. Proposers: W. T. Miller, C. F. Warner. Seconders: Y. Touloukian, A. C. Menke.

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Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by **Art. B-III**, *Section 8*, of the By-Laws, the following list of candidates elected:

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Brown, Coy W., Engr., General Electric Co., Bloomfield, N. J.
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Carofano, Dominick A., Engr., Behr-Manning Corp., Troy, N. Y.

Feldstein, Harold, Mgr., Valley Temperature Control Co., Glendale, California. *(Advancement)*

Ghosh, B. B., Government of India, Calcutta, India. *(Advancement)*

Hussar, Ernest A., Jr., Pres., Atlantic Air Conditioning Corp., Miami, Florida.

Milnes, Albert, Tech. Dir., Spirax Mfg. Co., Ltd., Cheltenham, Glos, England.
Moesel, Fred L., Owner, Fred L. Moesel Assoc., New York City, N. Y.
Montgomery, Cornelius T., Sr., Partner & Engr., Bowman & Montgomery Co., Bethlehem, Pa.

Peters, Herbert H. Instructor, Milwaukee School of Engrg., Milwaukee, Wisconsin. *(Reinstatement)*
Phillips, Eric G., Partner, Messrs. E. G. Phillips Son & Norfolk, Nottingham, England.
Pride, Charles F., Mech. Engr., The Austin Co., Oakland, Calif.

Ramoneda, Enrique, Owner, Mexico D. F., Mexico. *(Advancement)*
Rapp, Edgar A., Dist. Repr., General Electric Co., Dallas, Texas.

Stafford, Thomas D., Vice Pres. & Gen. Mgr., Alexander-Stafford Corp., Grand Rapids, Mich. *(Advancement)*

Weber, William A., Mech. Engr., Bell & Eiss, Inc., Minneapolis, Minn. *(Advancement)*
White, F. R. L., Chief Tech. Officer, The Brightside Foundry & Engrg. Co., Ltd., Birmingham, England.

Associate Members

Aminoff, Eugene, Mng. Dir., Varme & Sanitetsaktiebolaget, Stockholm, Sweden.

Bailey, A. E. Engr., Frigidaire Sales Corp., Roanoke, Va. *(Reinstatement)*
Beineke, R. C., Engr., Fosdick & Hilmer, Cincinnati, Ohio.
Bolle, F. G., Jr., Asst. Gen. Foreman, J. Brodie & Son, Inc., Detroit, Mich.
Brown, Norman L., Field Serv. Engr., A. M. Byers Co., Pittsburgh, Pa.
Browne, S. D., Engr., Barber-Colman Co., Rockford, Ill.
Bunn, J. W., Jr., Engr., General Air Conditioning Co., Raleigh, N. C.

Clegg, Eugene, Phoenix City, Alabama.
Collette, John R., Fitzgibbons Boiler Co., Inc., New York, N. Y. *(Reinstatement)*
Conway, F. J., Vice Pres., W. J. Gemeny Co., Chicago, Ill.
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Cullen, Charles W., Mgr., Peoples National Gas Co., Pittsburgh, Pa.

Duffy, Wm. R., Sales Engr., D. E. McCulley, Omaha, Nebr.
Dyer, Wm. K., Dist. Mgr., Buffalo Forge Co., Kansas City, Mo.

Earp, Samuel F., Sales Repr., Preferred Utilities Mfg. Corp., New York, N. Y.

Field, Erlund, Vice Pres., Whitty Co., Inc., Boston, Mass.

Gallagher, James M., Jr., Partner, J. M. Gallagher Co., Nashville, Tenn.
Gregorni, Nicholas A., Engr., R. B. Hayward Co., Chicago, Ill.

Harrower, William C., Dept. Head, Timken Silent Automatic Div., Jackson, Mich. *(Reinstatement)*
Heckert, Wm. P., Owner, Heckert Sheet Metal Wks., Kansas City, Mo.
Hoffman, Harry B., Owner, Hoffman & Hoffman Co., Greensboro, N. C.
Hofmann, Erwin A., Engr., Matt Grage, Heating Contractor, Chicago, Ill.

Ingram, J. D., Retail Sales Mgr., A. F. Coats Lumber Co., Tillamook, Ore.

Jones, Leslie R., Sales Engr., Pacific Pumping Co., Portland, Ore.
Jungels, John W., Mgr., Differential Htg. & Serv. Dept., C. A. Dunham Co., Chicago, Ill.

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Keck, Edward T., Jr., Applic. Engr., A. M. Lockett & Co., Ltd., Dallas, Texas.
Keperling, Harold R., Engr., Gilbert Assocs., Inc., Reading, Pa.

Lamb, Jordan H., Engr., Twin Coach Co., Kent, Ohio.
Lamoureux, Philip J., Sales Engr., E. R. Clement, Inc., Fairfield, Conn.
Lancaster, H. W., Jr., Co-partner, H. W. Lancaster & Sons, Memphis, Tenn.
Larter, Earle A., Supt. Mech. Trades, H. H. Angus & Assocs., Toronto, Can.
Lund, J. F., Sales Mgr., The Dole Valve Co., Chicago, Ill.

Manivelu, M., Engr., Spencer & Co., Ltd., Madras, India.
McClean, Fred C., Pres.-Treas., Fred C. McClean Heating Supplies, Inc., Springfield, Mass.
McIntosh, John W., Salesman, Amer. Rad. & Standard San. Corp., Memphis, Tenn.
Morse, Frederick B., Instructor, Purdue University, Lafayette, Ind.
Myers, John A., Owner, J. A. Myers Co., Columbus, Ohio.

Neuman, S. I., Sr. Tech. Asst., W. H. Brady & Co., Ltd., Bombay, India.

O'Connell, Patrick M., Secy.-Treas., The Dell Corp., Morton Grove, Ill. *(Reinstatement)*
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Roffee, Lawrence W., Mech. Engr., U.S. Bureau of Reclamation, Denver, Col.

Ross, B. W., Sales Engr., So. African General Elec. Co., Cape Town, South Africa.

Rugg, H. H., Sales Repr., The Wm. Powell Co., St. Paul, Minn.

Salter, Thomas J. Jr., Engr., Heating & Air Cond'g. Supply, Inc., Reno, Nevada.

Schilken, Donald R., Indus. Sales Mgr., Alexander-Stafford Corp., Grand Rapids, Mich.

Simpson, Harry A., Owner, Simpson Engrg. Service, Memphis, Tenn.

Singer, G. G., Pres., Atlas Industries, Ltd., Montreal, Que., Canada.

Smith, Jay V., Engr., Western Furnaces, Inc., Tacoma, Wash.

Stanek, Edward W., E. J. Stanek, Cleveland, Ohio.

Swart, Robert H., Mgr., Michigan Automatic Htg. Equip. Co., Grand Rapids, Mich.

Szymanski, Stanley R., Htg., & Air Cond. Supply, Inc., Reno, Nevada.

Twine, Harry J., Eastern Adv. Mgr., Htg. & Vent'g. Magazine, New York, N. Y.

West, Lionel C., Retail Engr., Iron Fireman Mfg. Co. of Canada, Ltd., Toronto, Ont., Canada.

White, Ralph A., Owner-Mgr., White Engineering Co., Graham, N. C.

Will, Donald S., Sales Engr., Payne Furnace Co., Long Beach, Calif.

Wilson, Charles H., Engr., Ford Motor-Northville Climate Control, Detroit, Mich.

Wilson, Thomas B., Engrg. Consultant, Owner, Yorkshire, England.

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Cox, Robert M., Florida Hill York Corp., Miami, Florida.

Curtis, Grant B., Jr., Htg. Engr., Crane Co., Atlanta, Ga.

El Attar, Ahmed Anwer, Engr., Koldair, S.A.E., Pasha, Cairo, Egypt.

Howard, Douglas L., Jr. Engr., Carrier Corp., Atlanta, Ga.

Huntington, R. Lee, Engr., Ben Huntington & Sons, San Diego, Calif.

Jacobson, Elliot L., Estimator, A. D. Jacobson Plbg. & Htg. Co., Kansas City, Mo.

Maley, Daniel P., Jr., Jr. Engr., Martyn Brothers, Inc., Dallas, Tex.

Nesteruk, Walter M., Engr., Pyle-National Co., Chicago, Ill.

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Smith, Donald S., Jr. Engr., Natkin & Co., Houston, Texas.

Ward, David, Draftsman, The Trane Co. of Canada, Ltd., Toronto, Ont., Canada.

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Student Members

Bareither, Harlan D., Grad. Student, University of Illinois, Urbana, Ill.

Cohen, William P., Student, Carnegie Institute of Technology, Pittsburgh, Pa.

Hambley, Charles J., Student, Purdue University, Lafayette, Indiana.

Smithers, Theodore, Student, Cuyahoga Falls, Ohio.

W. A. EBERT DIES AFTER BRIEF ILLNESS

After a brief illness, W. A. Ebert, owner, Ebert Air Conditioning, San Antonio, Tex., died on October 7, 1947. A member of the Society since 1920, Mr. Ebert was active in the formation of the Southwest Texas Chapter of the ASHVE in 1946.

A native of Chattanooga, Tenn., Mr. Ebert was born on April 15, 1885. He attended public schools and later took an ICS course in heating and ventilating engineering.

After an extensive apprenticeship in the heating, ventilating, and allied industries, Mr. Ebert started his own business in 1909 as a contractor in Beaumont and Port Arthur, Tex. In 1916 he represented the Houston branch of the N. O. Nelson Co., in the Southwest Texas area. He became affiliated with A. H. Shafer, contractor, San Antonio, Tex., as an estimator and engineer in 1918. At this time, he also acted as a manufacturers' agent, and as a heating engineer for several architectural firms. He later became a partner in the Ebert Air Conditioning firm in San Antonio, and at the time of his death was sole owner of this firm.

He is survived by his widow, Mrs. Hudson Ebert, to whom the Officers and Council of the American Society of Heating and Ventilating Engineers extend their heartfelt sympathy.

WASHINGTON, D. C. MEMBER DIES AT 36

C. W. Jenkins, Washington, D.C., a member of the society, and district representative, Taco Heaters Inc., died on September 30, 1947.

Mr. Jenkins was born on May 29, 1911, in Salisbury, North Carolina. He attended Eastern High School prior to entering the University of Maryland. In 1936 he received his degree from Columbia Technical Institute, Washington, D.C. His first position was as a topographic draftsman with the U. S. Department of Commerce. While attending Columbia Technical Institute he was employed by the Standard Oil Co., of New Jersey, as a representative. In 1936 he joined the staff of the American Radiator and Standard Sanitary Corp., where he was employed for the next six years as an estimator, and in sales and engineering work. From 1942 until 1944 he served as senior administrative assistant with the U. S. War Department, office of chief of engineers, construction division, in Washington, D.C. He became associated with Taco Heaters Inc. in 1944.

The Officers and Council of the American Society of Heating and Ventilating Engineers join the members of the Washington D.C. chapter in extending their sincerest sympathy to his family.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

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Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, G. E. Adema, 39 W. Balcom St., Buffalo 9. Secretary, J. H. Bryce, 88 E. Girard Blvd., Kenmore.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, J. R. Vernon, 507 E. Michigan St., Milwaukee 2. Secretary, B. M. Kluge, 1817 S. 66th St., Milwaukee 14.

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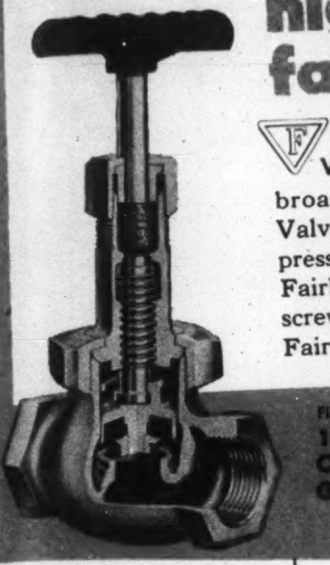

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Fig. U-01
150 Pound COMPOSITION DISC GLOBE VALVE

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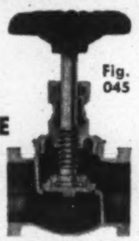

Fig. 045

BRONZE GLOBE AND ANGLE VALVE with Bronze Disc

Screwed-in Bonnet, integral seats. Rugged, compact with exceptional resistance to pressure and pipe strains. For steam, water, gas and oil – 125 lbs steam pressure.

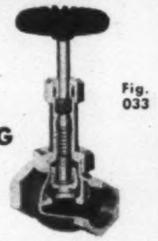

Fig. 033

REGRINDING Globe, Angle and Cross

Bronze disc—integral seat—union bonnet—200 and 300 pound pressures. For higher pressure service where composition discs are not satisfactory

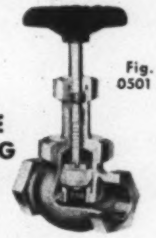

Fig. 0501

RENEWABLE REGRINDING Globe and Angle

Nickel alloy seat and disc—union bonnet—200 and 300 pound pressures. For more severe services on steam, water, oil, gas and air.

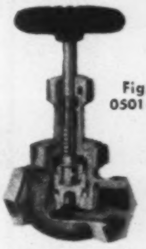

Fig. 0501-P

PLUG DISC AND SEAT Globe and Angle

Renewable hardened nickel alloy seat and disc—200 pound pressure. For throttling and other service requiring close regulation of flow.

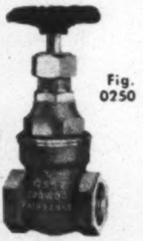

Fig. 0250

NON-RISING STEM Gate Valves

Screwed bonnet – solid wedge – taper seat 125, 150 and 300 pound pressures. For full flow of steam, water, oil and gas.

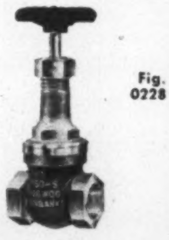

Fig. 0228

RISING STEM Gate Valves

Screwed bonnet – split wedge – solid wedge for 125 and 150 pound pressures. For steam, water, oil and gas.

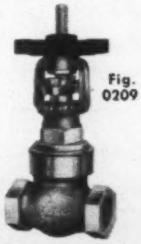

Fig. 0209

OUTSIDE SCREW AND YOKE Gate Valves

Screwed bonnet – solid wedge – taper seat – 150 and 300 pound pressures, where operating threads must not contact fluids.

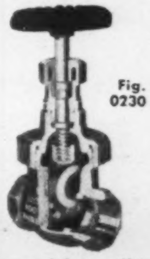

Fig. 0230

UNION BONNET Gate Valve

Non-rising stem – nickel alloy wedge–integral seat–200 pound pressure. For higher pressures on steam, water, oil and gas.

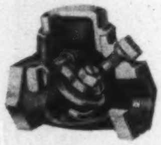

Fig. 0601

SWING CHECK VALVES

Horizontal—renewable bronze disc—125, 150, 200 and 300 pound pressures. For maximum flow of steam, water, oil and gas.

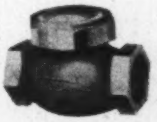

Fig. 0616

LIFT CHECK VALVES

Horizontal—angle. Renewable composition disc for 150 pounds—regrinding bronze disc for 200 and 300 pounds. To prevent return flow. Positive vertical lift of discs.

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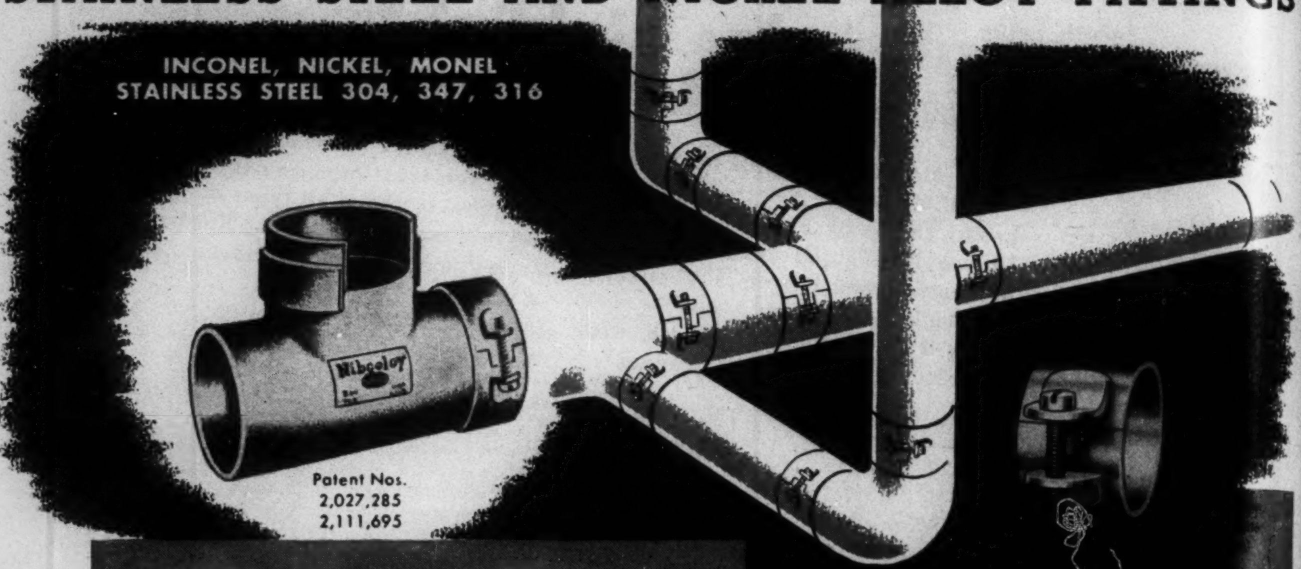

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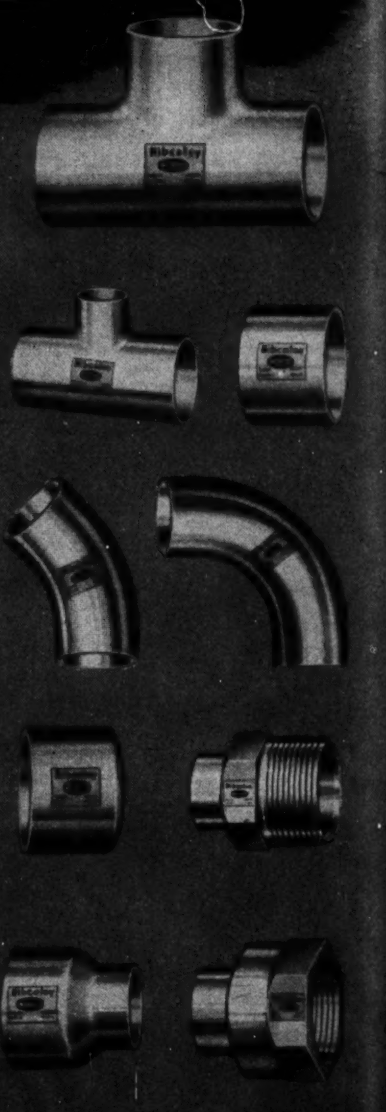

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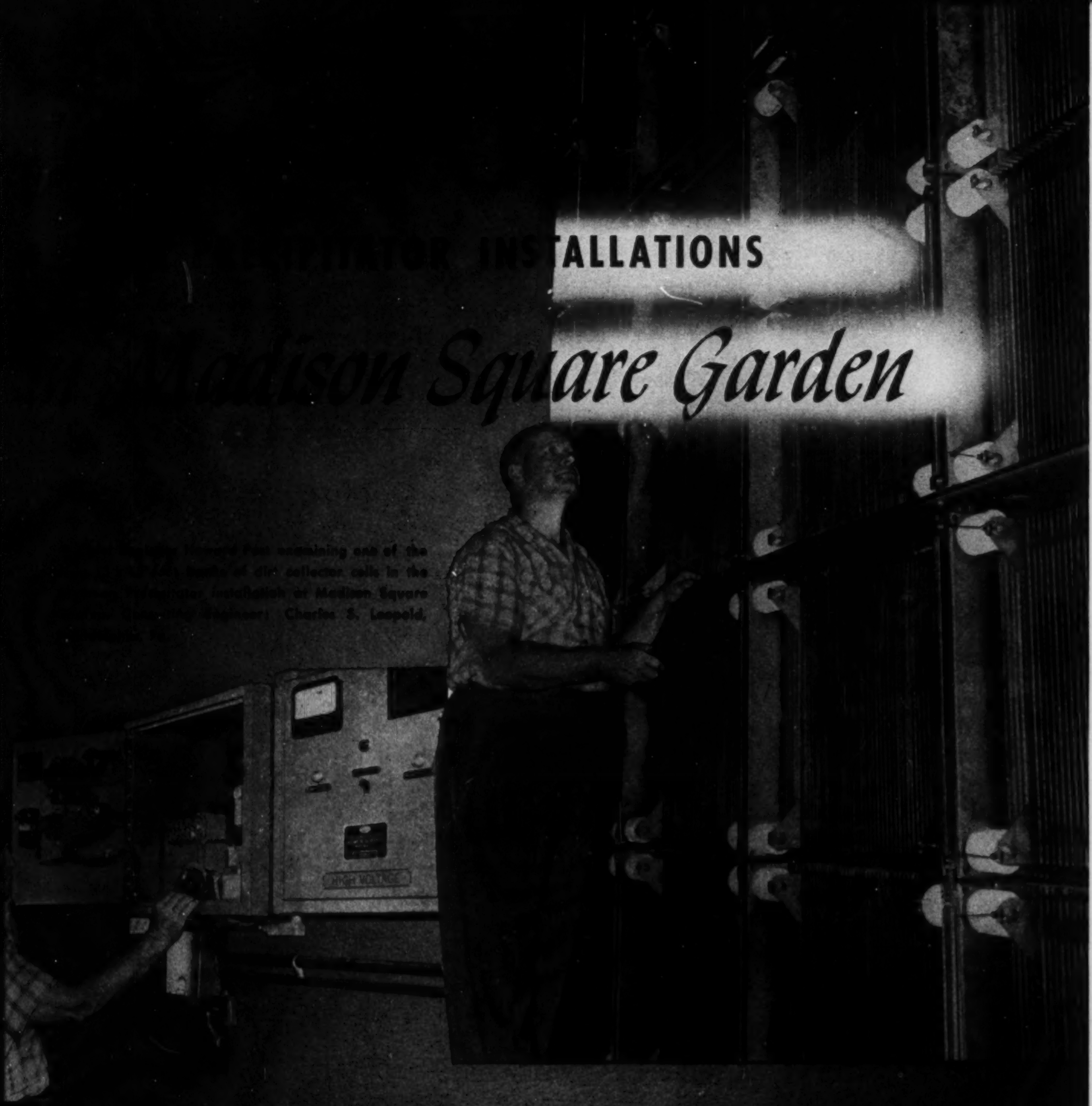

[illegible] Howard Post examining one of the [illegible] banks of dirt collector cells in the [illegible] Precipitator installation at Madison Square [illegible] Engineer: Charles S. Leopold, [illegible]

[illegible] built into the air conditioning [illegible] installation was made to [illegible] discomforting tobacco [illegible] vision. [illegible] our specifi- [illegible]

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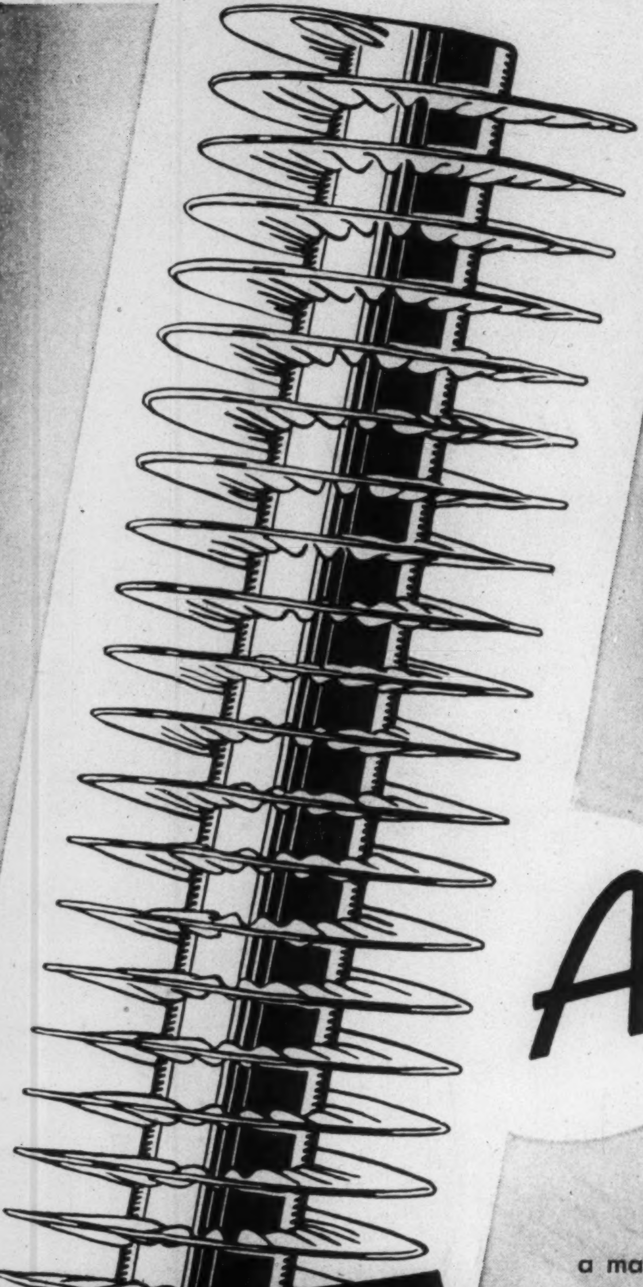

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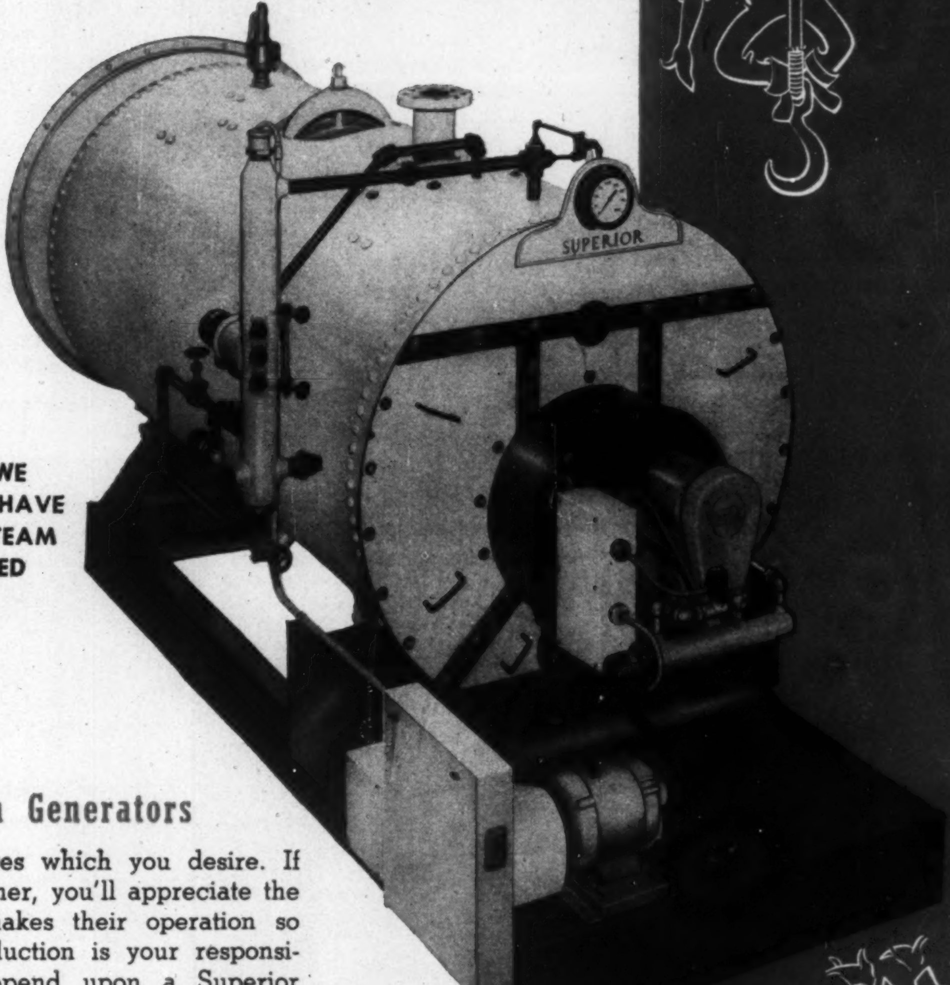

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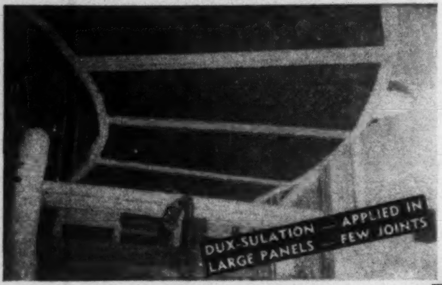
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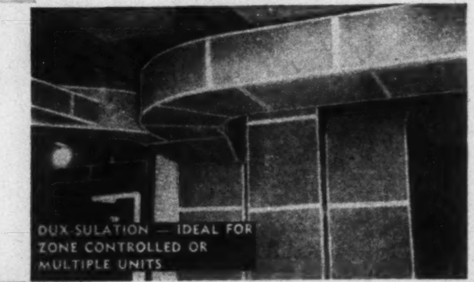
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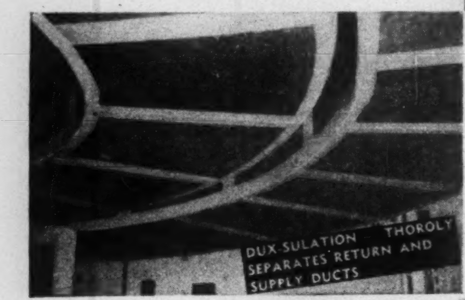
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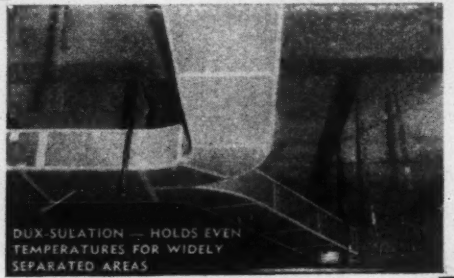
Confining the desired temperatures inside of the Ducts permits a more economical Duct layout.

DUX-SULATION PRACTICAL FOR COMPLICATED DUCT SYSTEMS

Maintain the System-Balance by completely insulated separation of Hot, Cold and Ventilating Ducts.

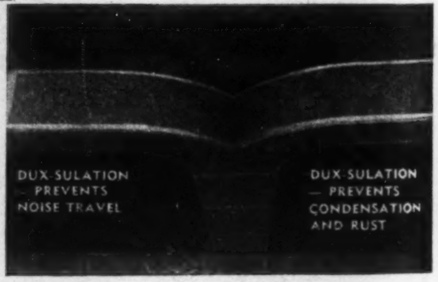

DUX-SULATION — HOLDS EVEN TEMPERATURES FOR WIDELY SEPARATED AREAS

Conserve metal by reducing Duct area and insulate to make up the efficiency.

DUX-SULATION

DUX-SULATION is a flexible insulating felt, made 1/2" and 1" thick and is put up in an easy-to-handle Roll, 36" wide, containing 100 square feet. Special adhesive for securely cementing the insulating felt onto the metal and Asbestos-faced Tape for covering the joints and corners, comes with each Roll.

Don't let warm Duct Lines running through unheated or unexcavated areas pull down the Duct System temperature.


DUX-SULATION — PREVENTS NOISE TRAVEL
DUX-SULATION — PREVENTS CONDENSATION AND RUST

Prevent noises from one area being communicated into other areas, offices, studios, apartments, etc.

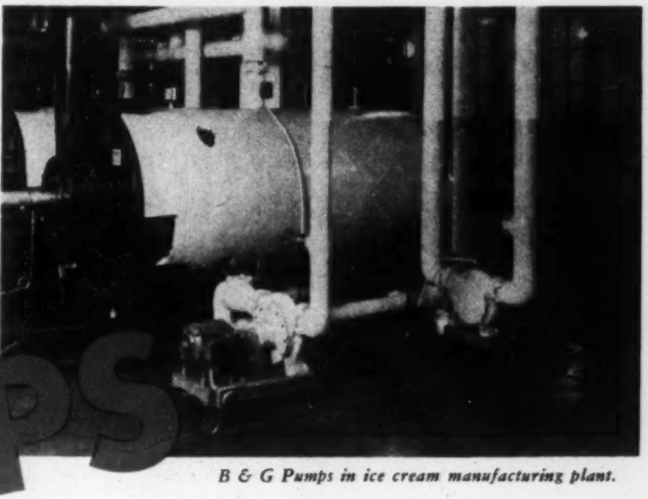
Write today for illustrated Bulletin No. 412-P.

GRANT WILSON, INC.
141 WEST JACKSON BLVD. AT LA SALLE ST. CHICAGO 4, ILL.
22nd Floor Board of Trade Bldg. Phone Wabash 8220

Get extra services by ordering DUX-SULATION from your local supply house

***THROUGHOUT CANADA* — Atlas Asbestos Co., Ltd., Montreal — Toronto — Winnipeg — Vancouver**

B & G Booster installed in residential forced hot water heating system.



B & G Pumps in ice cream manufacturing plant.

PUMPS FOR HOME AND INDUSTRY

...by the makers of ~~Hydro-Flo~~ HEATING PRODUCTS

You can sum up the reasons for the universal acceptance of B & G Pumps in a single statement—"sound engineering, backed by modern manufacturing methods capable of translating good design into fine product."

When you specify "B & G" you are assured that full value will be delivered, both in long service life and low cost operation.

HEATING PUMPS FOR COTTAGE OR SKYSCRAPER

B & G Boosters, for example, have a nation-wide reputation for completely dependable operation in forced hot water heating systems. *Over a half million Boosters have been installed to date* in buildings of every size and character! B & G Centrifugal Pumps, for industrial applications, are likewise known for design features and precision workmanship which satisfy the most critical engineers and operating men.

B & G Booster

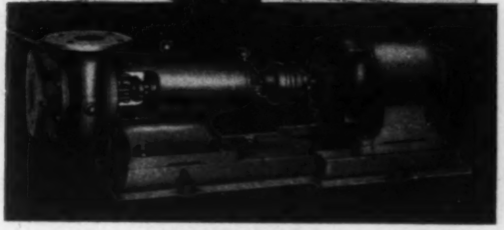
A centrifugal pump for forced hot water heating systems. Genuine circulating oil lubrication—Mechanical Seal eliminates a stuffing box.

centrifugal
PUMPS

Complete descriptions and engineering data on B & G Centrifugal Pumps are given in a series of bulletins you should have. Write for your copies today.

B & G Series 1522

Features a Mechanical Seal, instead of a stuffing box, hence successfully handles liquids usually hard on pumps. Standard motors, spring-type flexible coupling—interchangeable parts.



Series 1510-1515

Base-mounted, flexible coupled units with semi-open or enclosed impellers. Accurate machining and mechanical balancing assure quiet operation and peak efficiency.

CENTRIFUGAL PUMPS

BELL & GOSSETT CO.

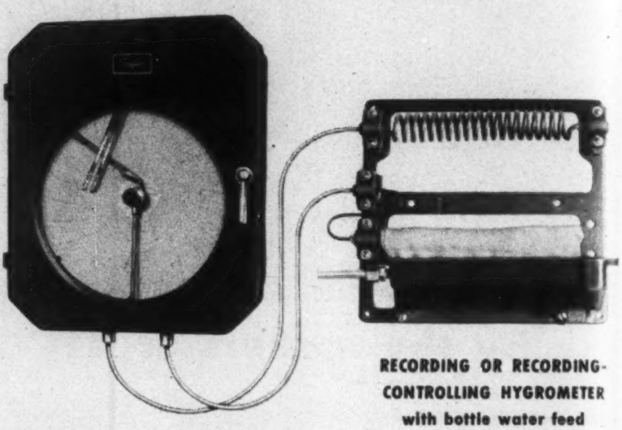
Dept. AH-5, Morton Grove, Illinois

You need these instruments for
MORE ACCURATE AIR CONDITIONING

ACCURATE measurement and control of air temperatures are vital to any efficient air conditioning system. Taylor's highly sensitive temperature measuring systems result from years of experience in measuring air temperatures. The control systems are not only precise in their control—they're simple, dependable and economical to operate, and easy to maintain.

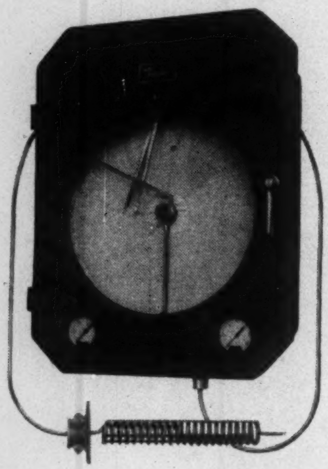
When modernizing existing equipment or purchasing new systems, specify "Taylor-Equipped As Usual". Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ontario.

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.



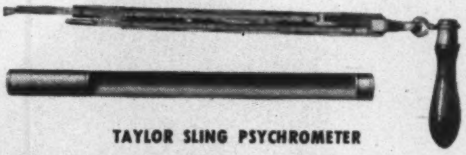
RECORDING OR RECORDING-CONTROLLING HYGROMETER
with bottle water feed

Recommended under the following conditions: good air circulation; panel advantageously located within apparatus, room or duct for best circulation across the bulbs. Also available with constant level water reservoir.



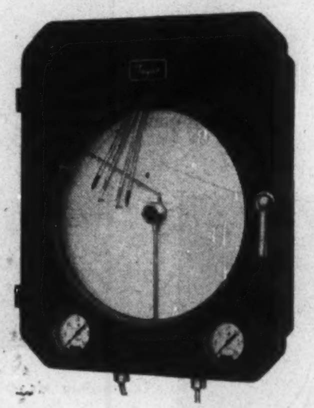
TAYLOR FULSCOPE TEMPERATURE CONTROLLER

Regulates lever motors, diaphragm valves, dampers, etc., to make your air conditioning system work perfectly. Automatically compensates for load changes. Controls refrigeration compressors. Gives you automatic seasonal change-over.



TAYLOR SLING PSYCHROMETER

The standard of comparison for accurate measurement of relative humidity since it provides a simple means for creating suitable circulation of air.



TAYLOR FULSCOPE RATIO RECORDING CONTROLLER

For applications where you need to maintain control in one medium in a definite relationship to some other variable medium . . . such as inside temperature control in summer air conditioning according to variable outdoor temperatures.

Taylor
WET
DRY

TAYLOR 10 BG HYGROMETER
with bottle-feed reservoir

Unique tube design combines accuracy of an etched-stem thermometer with sturdiness of an industrial thermometer. Easier to read, install and maintain. Ideal for air conditioning supply and return ducts, dryers, and other closed compartments where you want temperature and humidity readings.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

FREE! **NEW COMBINATION Ball Point Pen and Key Chain!**

To acquaint as many jobbers and dealers as possible with the superior features of Wilson's H*air* Filters, Wilson & Co. is offering these new, unique Ball Point Pens and Key Chains, *Absolutely Free!* Merely sign this coupon requesting information and send to address at bottom of this page. This offer will expire February 1st, 1948. H-12

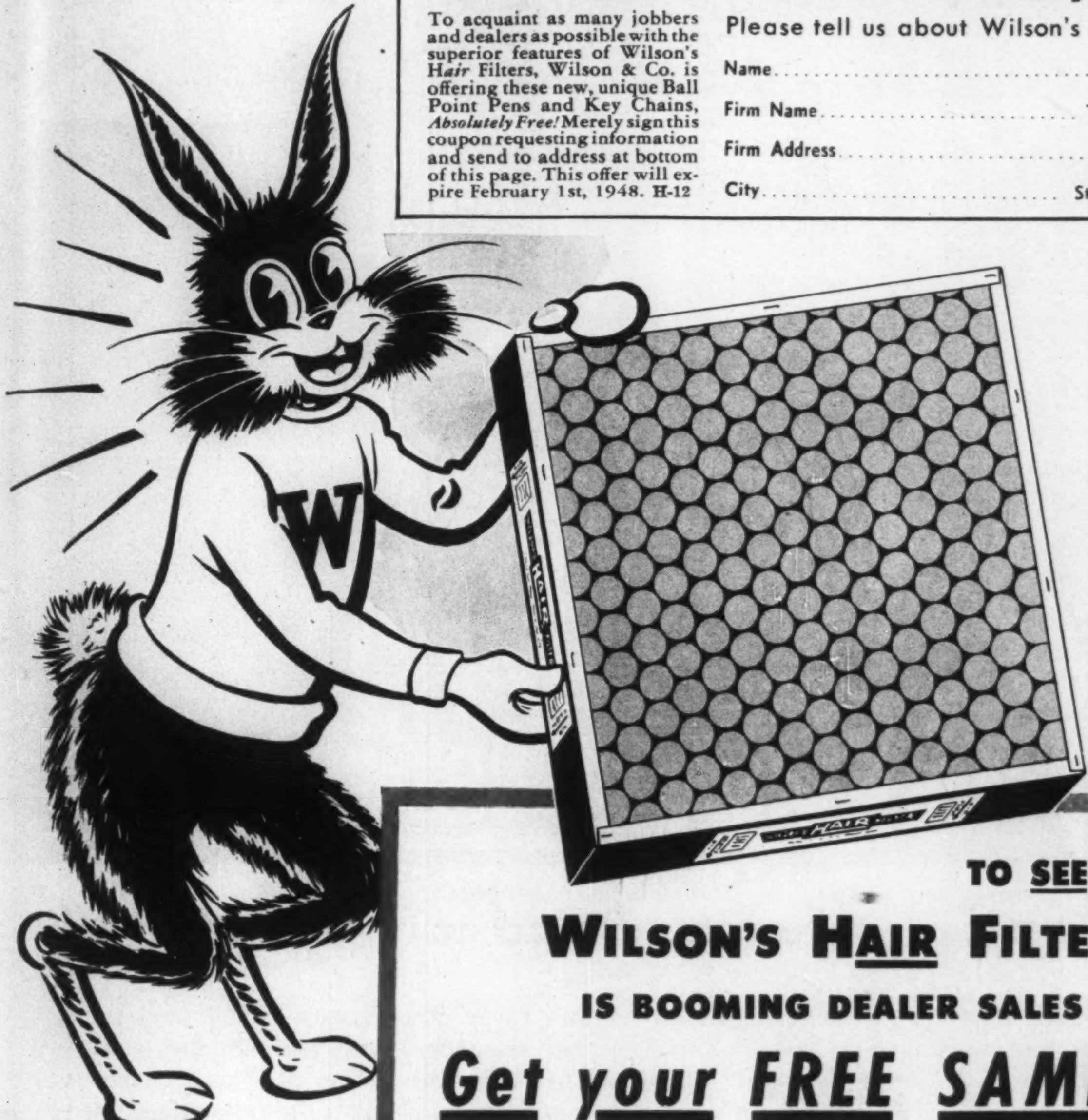
Please tell us about Wilson's H*air* Filters.

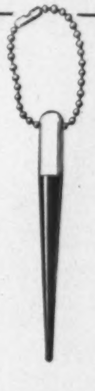
Name...

Firm Name.............................. Title...........

Firm Address...

City.................................. State............





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TO SEE WHY

WILSON'S HAIR FILTER

IS BOOMING DEALER SALES

Get your FREE SAMPLE!

SEE OUR EXHIBIT

at the Eighth Air Conditioning Exposition
Booth No. 323
Grand Central Palace, New York
February 2-6, 1948

Naturally it's easy for the public to see that *natural hair* would do the best job of filtering the air. It's nature's way in the nose and ears. And Wilson's H*air* Filter in its smart "honeycomb" replacement unit sure has eye-appeal. It's the smart thing for you to sell and the smart thing for home and building owners to use. And *that* combination means sales and repeat sales. Send for your free sample and our proposition today.

THE HAIR THAT CLEANS THE AIR
WILSON'S HAIR FILTER

MEMBER INDOOR COMFORT

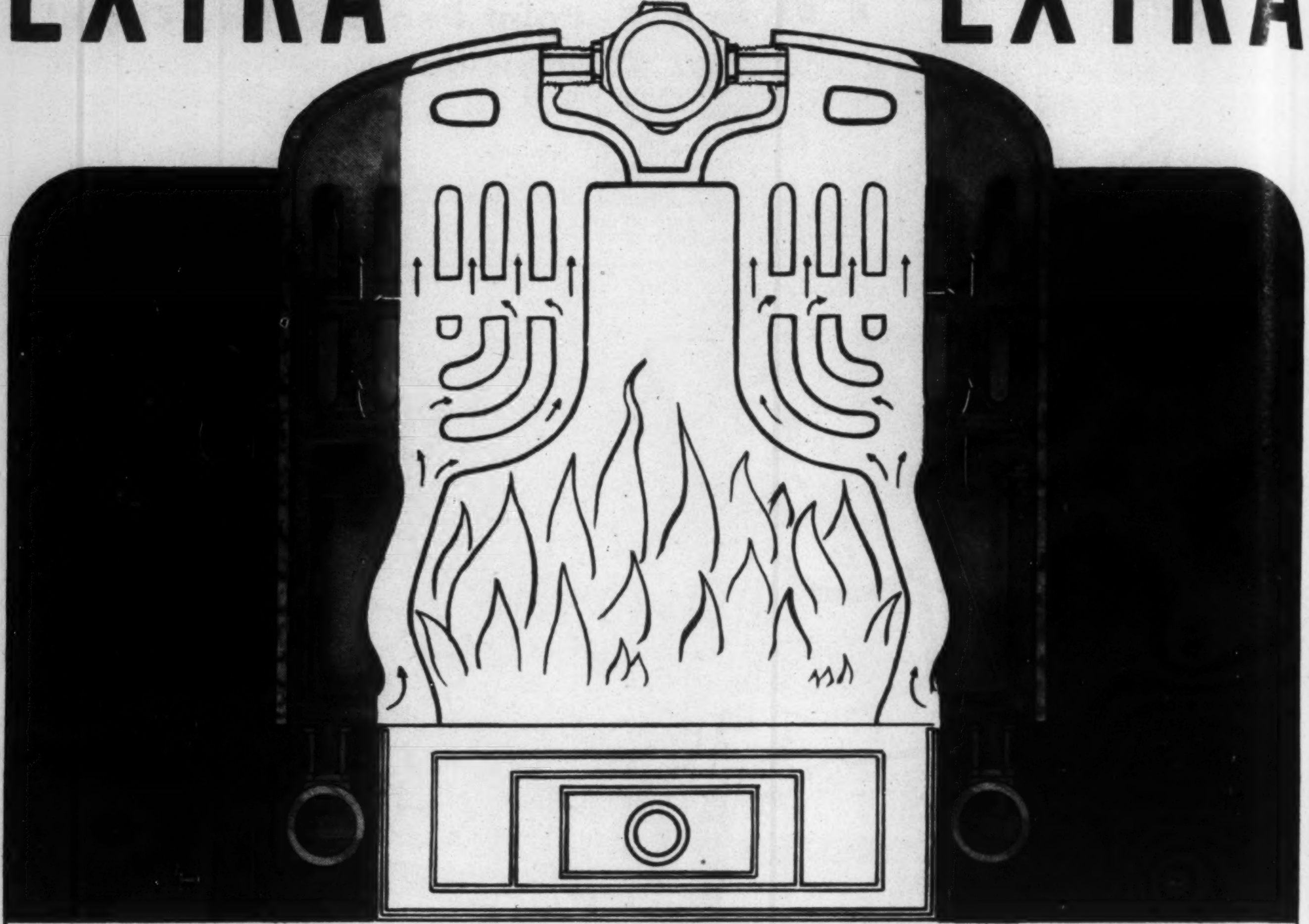
Wilson & Co., Inc. (Air Filter Division)
4100 So. Ashland Ave., Chicago 9, Ill.

WILSON & CO. INC.

Western States Representatives:—HAROLD WINNINGHAM & COMPANY • SEATTLE • SAN FRANCISCO • LOS ANGELES • SALT LAKE CITY • DENVER • EL PASO

WILSON'S HAIR FILTER

EXTRA EXTRA

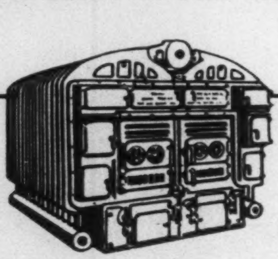


"Extra . . . Extra, Read all about it!"

H. B. Smith Cast-Iron Boilers are packed with *extra* heating surface . . . you can read all about it in H. B. Smith literature. The *extra* that means real fuel economy is in the many *more* square feet of *direct* fire surface packed into H. B. Smith boilers.

Match this heating surface with that of any cast-iron boiler of equal grate area and you'll see why H. B. Smith boilers extract more value from each fuel unit burned. Conventional cast-iron boilers have *single* water tubes on either side of the fire pot; large H. B. Smith boilers have *two* vertical tubes, leading into many other vertical and lateral tubes that are packed with water backed surface. That means all the flue gases get a chance to scrub along this *extra* heating surface, *more* heat units are transmitted to the water.

That, too, is why H. B. Smith boilers are outstandingly efficient for automatic firing. There is plenty of heating surface to efficiently absorb the heat generated by intense, blast-like oil, gas or stoker flames . . . even at peak firing rates. *Extra* H. B. Smith heating surface is your guarantee of economical boiler operation.



H.B. Smith

CAST-IRON BOILERS

THE H. B. SMITH CO., INC., 64 Main Street, Westfield, Mass. Offices and Representatives in Principal Cities

Five Verti-Stacks remove 126 tons of water vapor every 24 hours at American Box Board Company, Grand Rapids, Michigan. Working around the clock, these sturdy ventilators have served more than ten years without a failure. "Best boost to production we ever made," says Plant Engineer Ira P. Nicole.

VERTI-STACKS *Keep Air on the Move*

The powerful suction of Propellair Verti-Stacks quickly and completely exhausts moisture, dust, fumes, and heat . . . pulls in clean air at worker level . . . *greatly increases plant productivity.* In hot summer weather, Verti-Stacks operated during the night quickly *sweep the entire building* with fresh cool air—leave it *right* for a vigorous morning start.

SCIENTIFICALLY DESIGNED

Propellair ventilating equipment is based on *proved engineering principles.* Airfoil section fan blades *pull* as they *push,* like an airplane wing—evenly distribute the load from tip to hub. Entrance ring prevents recirculation—pays off in positive, *high volume* air movement. Tireless, highly efficient, *job-proved* on countless applications, Propellairs meet all industrial requirements.

CUT INSTALLATION COSTS

Whatever the air-moving need, *there's a Propellair for the job.* Functional designs for roofs, stacks, ducts, walls, windows, and with floor stands or pedestals. Complete descriptions and engineering data are yours *for the asking.* Write today.

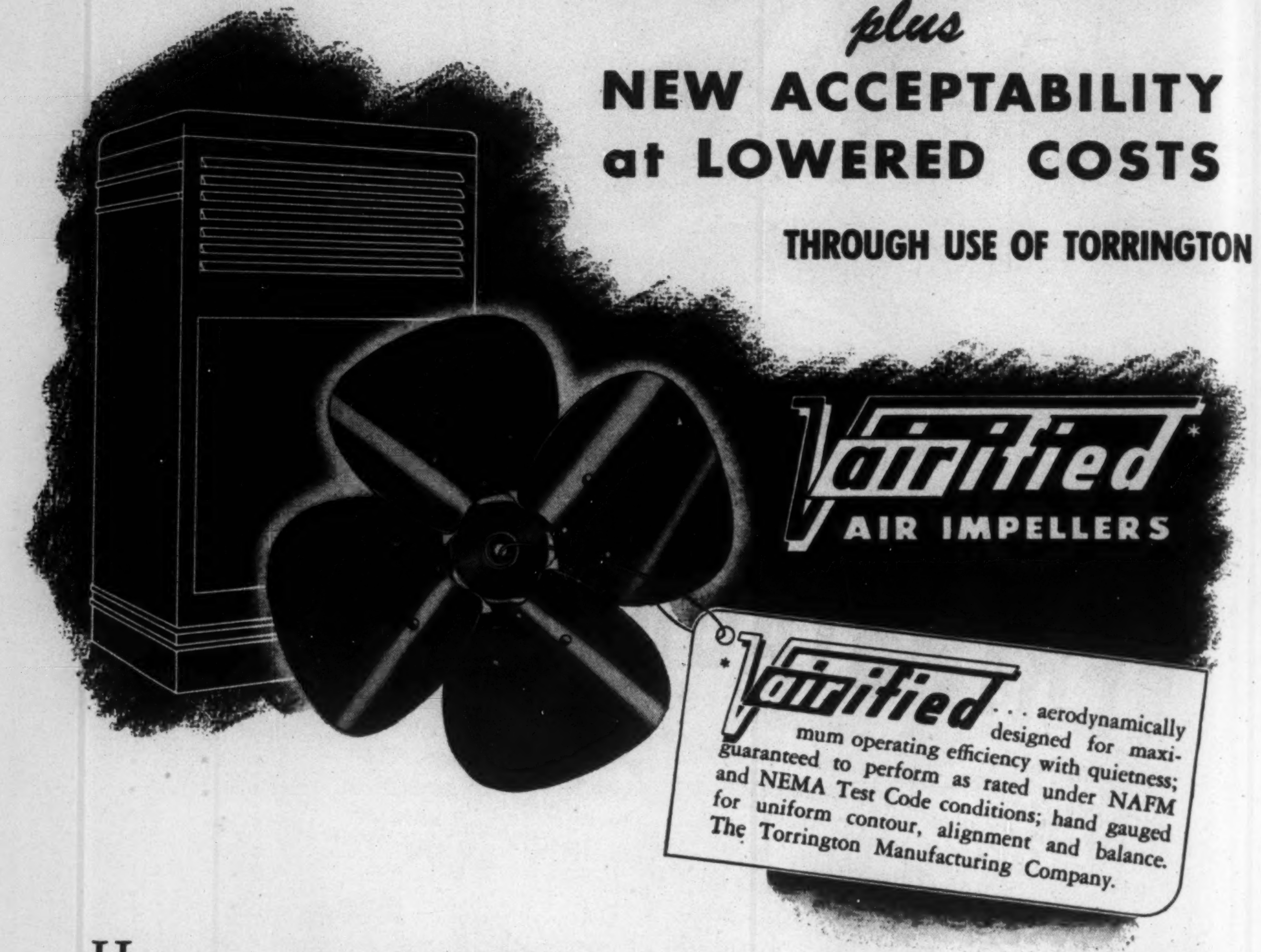
PROPELLAIR VERTI-STACKS. Butterfly dampers open and close automatically; offer negligible resistance to air flow. Diameters to 60 inches; capacities to 68,000 c.f.m.

PROPELLAIR DIVISION OF ROBBINS & MYERS • INC.
SPRINGFIELD • OHIO
"Moving Air is our Business"

SPACE HEATER MANUFACTURER GETS

BETTER PERFORMANCE *plus* NEW ACCEPTABILITY at LOWERED COSTS

THROUGH USE OF TORRINGTON

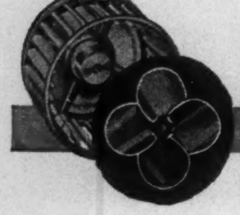


*Vairified . . . aerodynamically designed for maximum operating efficiency with quietness; guaranteed to perform as rated under NAFM and NEMA Test Code conditions; hand gauged for uniform contour, alignment and balance. The Torrington Manufacturing Company.

Here was a unit originally designed for simple *radiation* of heat. Realizing that the addition of forced air would bring broader consumer acceptance for the unit and improve his position competitively, this manufacturer came to us for advice.

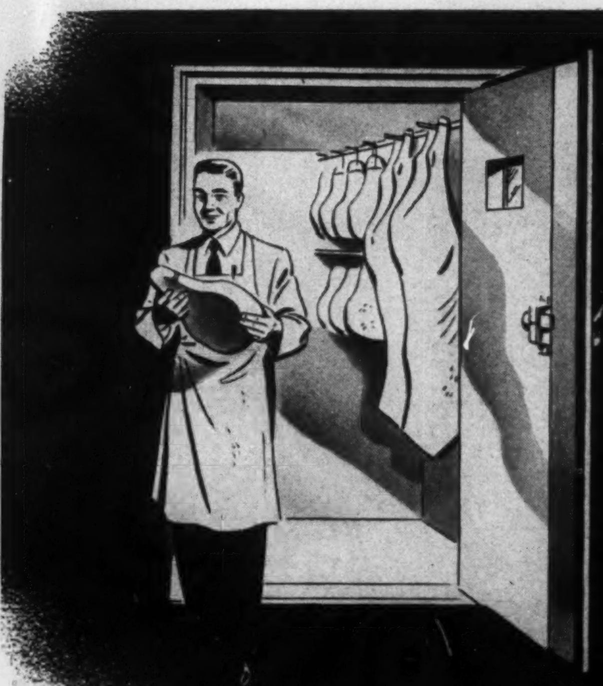
Torrington's laboratory technicians were able, after studying this unit, to not only obtain the desired heat distribution and cool certain exterior surfaces, but to suggest a slight design modification which would actually reduce manufacturing costs.

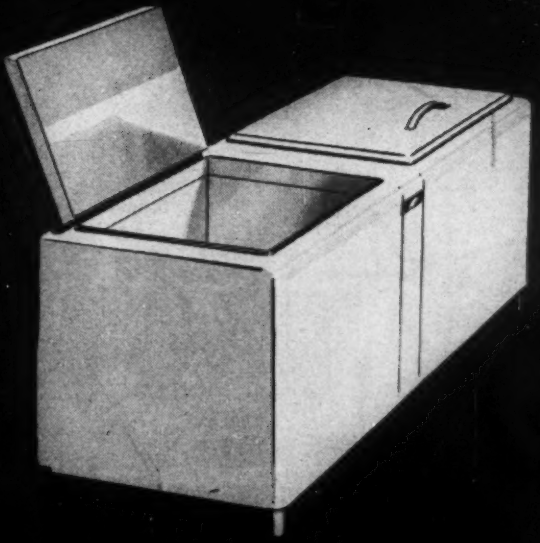
By consulting us in the early stages of your product's design, you too may be able to improve the performance of your product, effect savings in manufacturing costs. We offer this service without obligation.



THE TORRINGTON
MANUFACTURING COMPANY, TORRINGTON, CONNECTICUT

AIRISTOCRAT FAN BLADES • AIROTOR BLOWER WHEELS • IMPROVE PRODUCT PERFORMANCE





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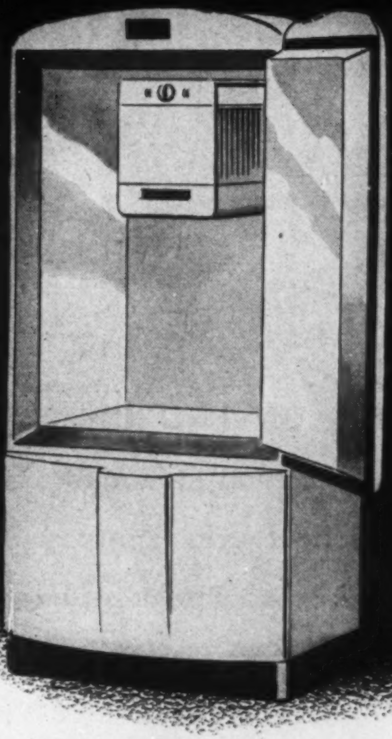


Make them from Alcoa Aluminum Sheet . . . cut out the cost of porcelain enamel finish. You can use aluminum liners with only an etched finish. They're easy to form and install without danger of marring. Won't chip or rust in service.

The thermal pulldown of aluminum liners is about 100% faster than for steel liners . . . aluminum has a thermal conductivity of approximately 1300 Btu/hr./in./ft.^{2}/°F. You get *faster cooling* when the liners are aluminum.

Production costs will be less when you use furnace brazing to join tube coils to liners. Liners when either spot-welded or argon-welded are watertight.

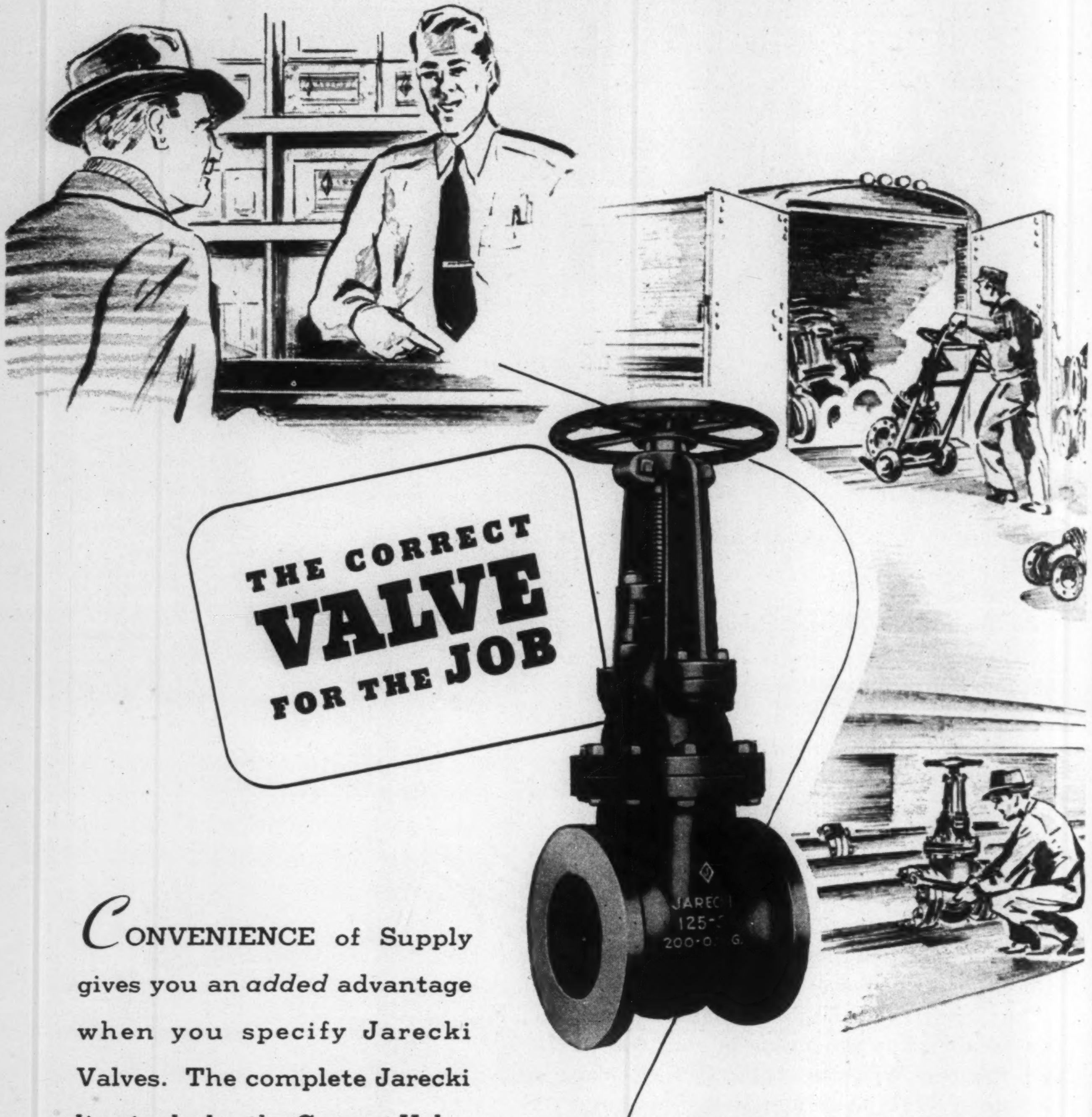
Our engineers will be glad to show you where and how to use Alcoa Aluminum in your refrigerators and freezers. Write to ALUMINUM COMPANY OF AMERICA, 1829 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in 55 leading cities.

MORE people want MORE aluminum for MORE uses than ever

ALCOA ALUMINUM

IN EVERY COMMERCIAL FORM

At Your Distributors' . . .


THE CORRECT
VALVE
FOR THE JOB
JARECKI
125-
200-O. G.

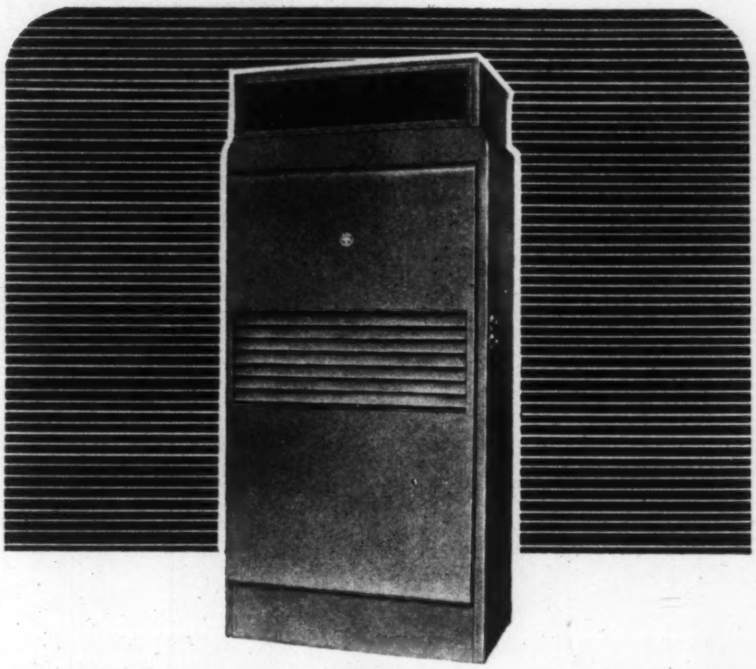
CONVENIENCE of Supply gives you an *added* advantage when you specify Jarecki Valves. The complete Jarecki line includes the Correct Valve For The Job.

Since 1852

JARECKI

Valves and Fittings

◆ **JARECKI MANUFACTURING CO.**
ERIE, PENNSYLVANIA



TYPHOON

presents

the latest technical developments in Self-Contained AIR CONDITIONING UNITS

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Fifth All-Industry

Refrigeration and Air Conditioning Exposition

Public Auditorium, Cleveland, Ohio

January 26 to 29

See our exhibit on "Cool Profits in
Air Conditioning"—Booth 907

●

and when you're in New York for the International Heating and Ventilating Exposition, February 2nd to 6th, visit our Brooklyn showroom—

TYPHOON AIR CONDITIONING CO., INC.

Division of

ICE AIR CONDITIONING CO., Inc.

794 UNION STREET BROOKLYN 15, N. Y.

If you make, design, specify,

or install equipment that uses or handles water

your reputation may come in a package

MICROMET
TRADE MARK REG. U. S. PAT. OFF.
for
SCALE PREVENTION,
CORROSION CONTROL
in Water Systems
CALGON INC.
PITTSBURGH, PA

You may make the best water heater in the world . . . or design air conditioners that are dream jobs . . . or write the stiffest pipe specs in the business . . . or install heating systems that can't fail.

But if you get into an area where corrosive water eats through piping in a few months, or where scale reduces the normal flow of water and blocks normal heat transmission through pipe walls, or where red water stains the Monday wash—your name is mud.

Micromet* has proved effective against all these conditions. Leading engineers and manufacturers use it and recommend it to increase the efficiency and service life of equipment. Over 600 cities use this type of material for threshold treatment of their water supplies.

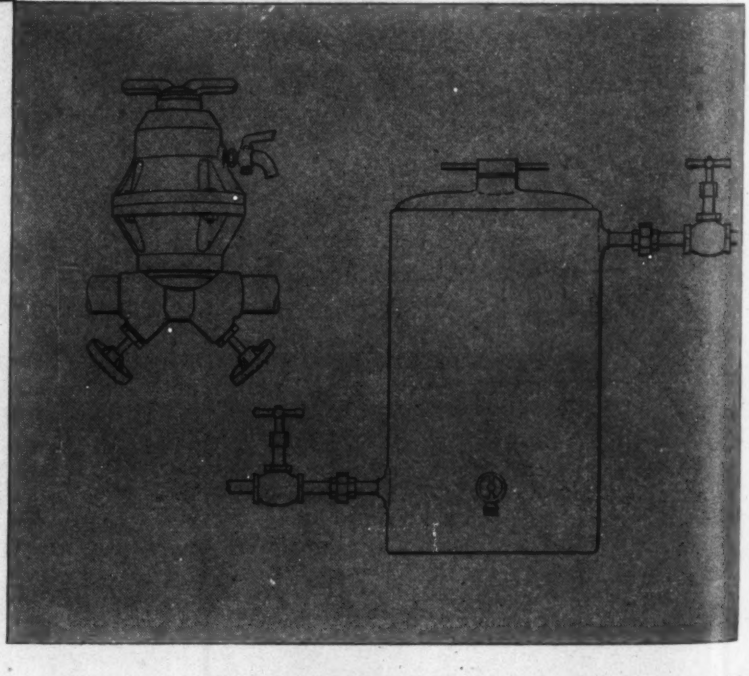
Specifically, Micromet is a slowly soluble vitreous phosphate made from food grade materials. Without affecting the taste or quality of water, it controls corrosion, clears up red water, and eliminates lime-scale.

*T. M. Reg. U. S. Pat. Off.

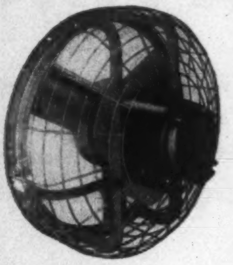
Simple, durable, carefully-engineered Micromet Feeders make the use of Micromet completely automatic. They are available in various sizes to condition water in quantities up to a million gallons per month. Thousands are in use now, in homes and small to medium-sized office, hotel, apartment, commercial and industrial buildings.

If you make . . . design . . . specify . . . or install equipment that uses or handles water—write for the complete story of Micromet.

CALGON, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

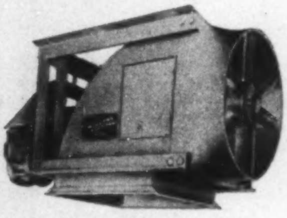


WING VENTILATING EQUIPMENT



WINGFOIL SAFETY VENTILATING FAN

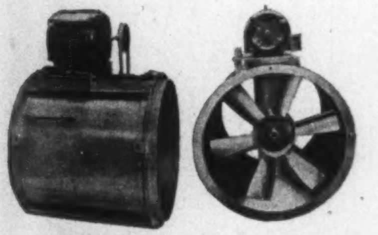
Distinguished for efficiency and rugged construction. The new Wingfoil fan wheel moves maximum volumes of air with minimum horsepower, due largely to its non-overloading feature. Sizes from 10" to 60" dia., with free air capacities from 860 to 58,000 CFM. Larger sizes on special order. Either direct or belt drive. Heavy steel guards provide safety.



WINGFOIL DUCT FAN

(Elbow Type)

Designed to form an elbow in the duct system, the elbow-shaped housing in a strong rectangular frame permits installation with the inlet in any desired position. Motor and drive are outside the air stream, therefore remain cool, clean, and easily accessible. The new Wingfoil Fan has a remarkable "non-overloading" characteristic. Sizes 10" to 60"; capacities up to 60,000 CFM.

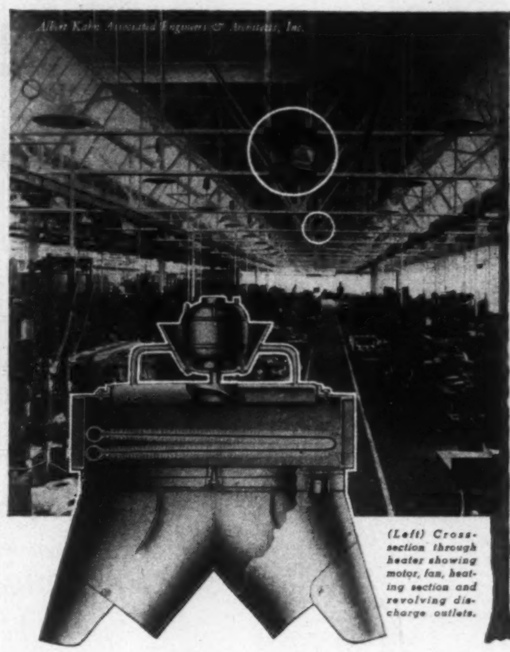


WINGFOIL DUCT FAN

(Straight Line Type)

Designed to form a part of any straight run of duct. The motor is mounted on an adjustable base outside of the housing. V-belt drive is through an air tube carried across the housing and supporting fan shaft and bearings. Fan wheel is the new, non-overloading Wingfoil Fan. Bearings are grease-sealed, requiring minimum of attention.

Write for Bulletins



(Left) Cross-section through heater showing motor, fan, heating section and revolving discharge outlets.

WING TURBINE DRIVEN REVOLVING UNIT HEATER

The Wing Turbine Driven Revolving Heater is a new type of unit heater in which the steam used for heating the air is first used to drive the fan, thus eliminating electric motor. This is accomplished by means of the new Wing Allsteel Steam Turbine. The turbine driven heater is especially valuable in installations where there is danger from explosive vapors, etc., although it may be used economically in practically any type of installation.

Why Many of the Country's Leading Industrial Plants Use Wing Revolving Unit Heaters

The remarkable feature of Wing Revolving Unit Heaters that distinguishes them from other types of heating systems is the fact that the discharge outlets *revolve*. This assures a thorough circulation of the heated air to all parts of the working level regardless of obstacles. The slowly revolving outlets gently distribute the heat continuously in a constantly changing direction, eliminating hot and cold spots, chill corners or concentrated blasts of hot air. They circulate the heat over, around and under obstructions, into out of the way corners, spreading an even, uniform blanket of warmth over the entire area.

The advantages of Wing Revolving Unit Heaters are:

1. Circulates the warm air completely and thoroughly regardless of obstructions.
2. Eliminates hot and cold spots, chill corners or concentrated blasts of hot air.
3. Reduces absenteeism due to colds resulting from drafts, chills or overheating.
4. Moving discharge quickly heats up plant in morning.
5. Makes workers feel comfortable, live and invigorated—more production.
6. Is an excellent cooling system in summer with steam off and fans on.

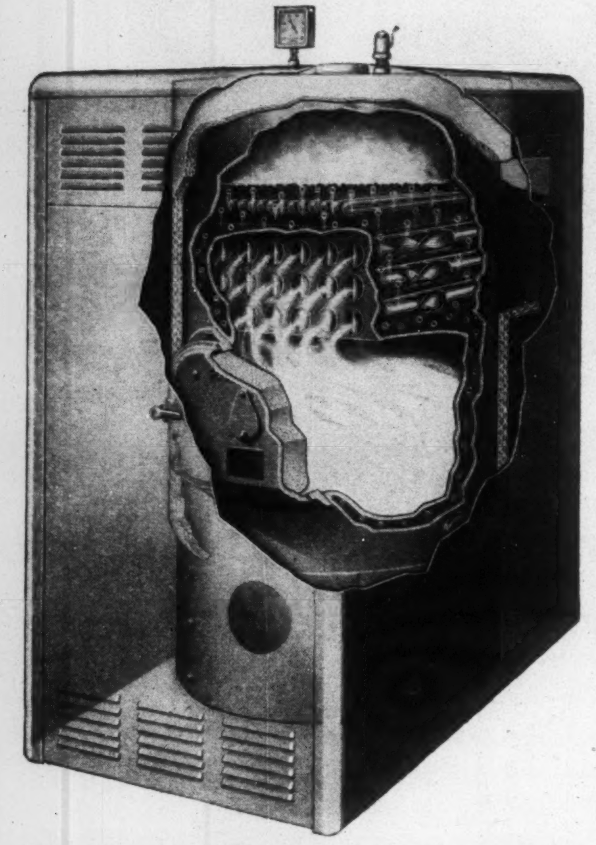
L. J. Wing Mfg. Co.

14th St. & Seventh Ave., New York 11 • Factories: Newark, N. J., and Montreal, Can.

Wing

TURBINE BLOWERS
MOTOR DRIVEN BLOWERS
DRAFT INDUCERS
REVOLVING UNIT HEATERS
UTILITY HEATERS
FLOODLIGHT HEATERS
STEAM TURBINES
FOG ELIMINATORS
PROCESS HEATERS
VENTILATING FANS
EXHAUSTERS
SHIP VENTILATORS

When you sell FITZGIBBONS you sell FUEL SAVING!



The FITZGIBBONS 400 SERIES is built in five sizes — 320 to 900 ft. steam — and comes complete with insulating jacket covering burner and all controls, with easily removable panels for servicing. Full details in the "400 Series" bulletin — just off the press.

TODAY, MORE THAN EVER BEFORE, the big demand in oil heating is FUEL SAVING. Sell a steel boiler that will surely do it. Sell the Fitzgibbons 400 Series, with these big advantages:

SELL THE "400 SERIES" COMBUSTION SPACE — *right* in form and size to bring out the best performance of any burner — sell the **POWERFUL WATER CIRCULATION** that is set up the instant the burner goes on — sell the famed **FITZGIBBONS QUICK HEATING,** that makes radiators snap into action in almost instant response to the thermostat's command, and saves several hours of burner operation per day — sell the **EASY CLEANING** that keeps the boiler at the peak of efficiency—sell the **FITZGIBBONS TANKSAVER*** for year 'round domestic hot water supply without a storage tank.

SELL ASSURANCE OF PERFORMANCE. Every Fitzgibbons "400" is built in accordance with the A.S.M.E. code, is inspected by the Hartford Steam Boiler Inspection and Insurance Co., and is accurately rated in accordance with the Steel Boiler Institute code. All this means *tops* in heating engineering standards, and notably low fuel bills.

SELL THE ADVANTAGE OF SIXTY-THREE YEARS of step-by-step development in steel boiler building, culminating in this 400 Series steel boiler. No quirks of design, no experiments. All those were washed off the slate long ago. What's left is all boiler.

SELL FUEL SAVING — YOU'LL DO IT WHEN YOU SELL THE FITZGIBBONS 400 SERIES.

*Reg. U. S. Pat. Off.

Reg. U.S. Pat. Off.

Fitzgibbons Boiler Company, Inc.
101 PARK AVENUE, NEW YORK 17, N. Y.
Manufactured at: OSWEGO, N. Y.
Sales Branches in Principal Cities

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SBI
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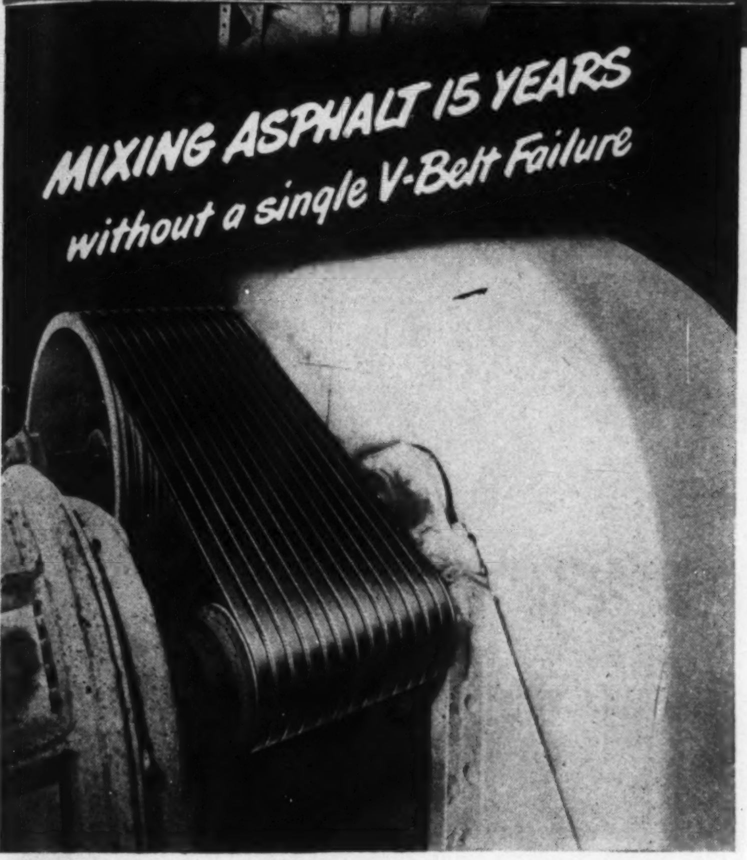
YOU ALWAYS BURN LESS IN A

FITZGIBBONS

WHY DAYTON V-BELTS *Last Longer*

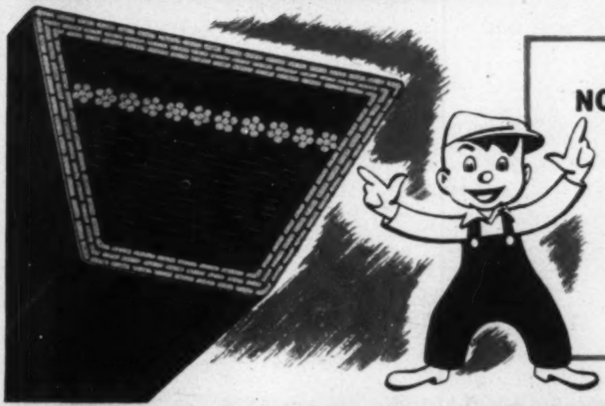


For 12 hours a day, every working day since the fall of 1931, the twin overhead asphalt mixers of a large building materials manufacturer were driven by two Dayton V-Belt Drives of 13 V-Belts each. The machines mix 900 tons of asphalt daily. Despite rock dust in the air, the heavy demands of a tough mixing job and other adverse operating conditions, not a single V-Belt failure occurred in over 15 years!

Dayton V-Belts deliver years of trouble-free service because they are built of *specialized* rubber, specially-treated Raytex Cords and other materials that give them the extra strength and toughness needed to take grueling punishment without stretch or failure. It's one reason why Dayton V-Belts can help you solve your power transmission drive problems efficiently and economically. Your Dayton Distributor will gladly help you select the correct V-Belts and pulleys for any power drive. Call him today.

DAYTON RUBBER • DAYTON, OHIO

Branch Offices: Atlanta • Boston • Chicago • Cleveland
Dallas • Detroit • Los Angeles • Minneapolis
New York • Philadelphia • St. Louis



NOW! *Rayon Cords PROVIDE DAYTON V-BELTS

WITH
1. **MINIMUM STRETCH**
2. **GREATER FLEX STRENGTH**
3. **LONGER V-BELT LIFE**

*** Rayon Cords are specially processed by Dayton for use in V-Belts to provide the most efficient and economical power transmission service for your needs. For the complete story write for Booklet A-469.**

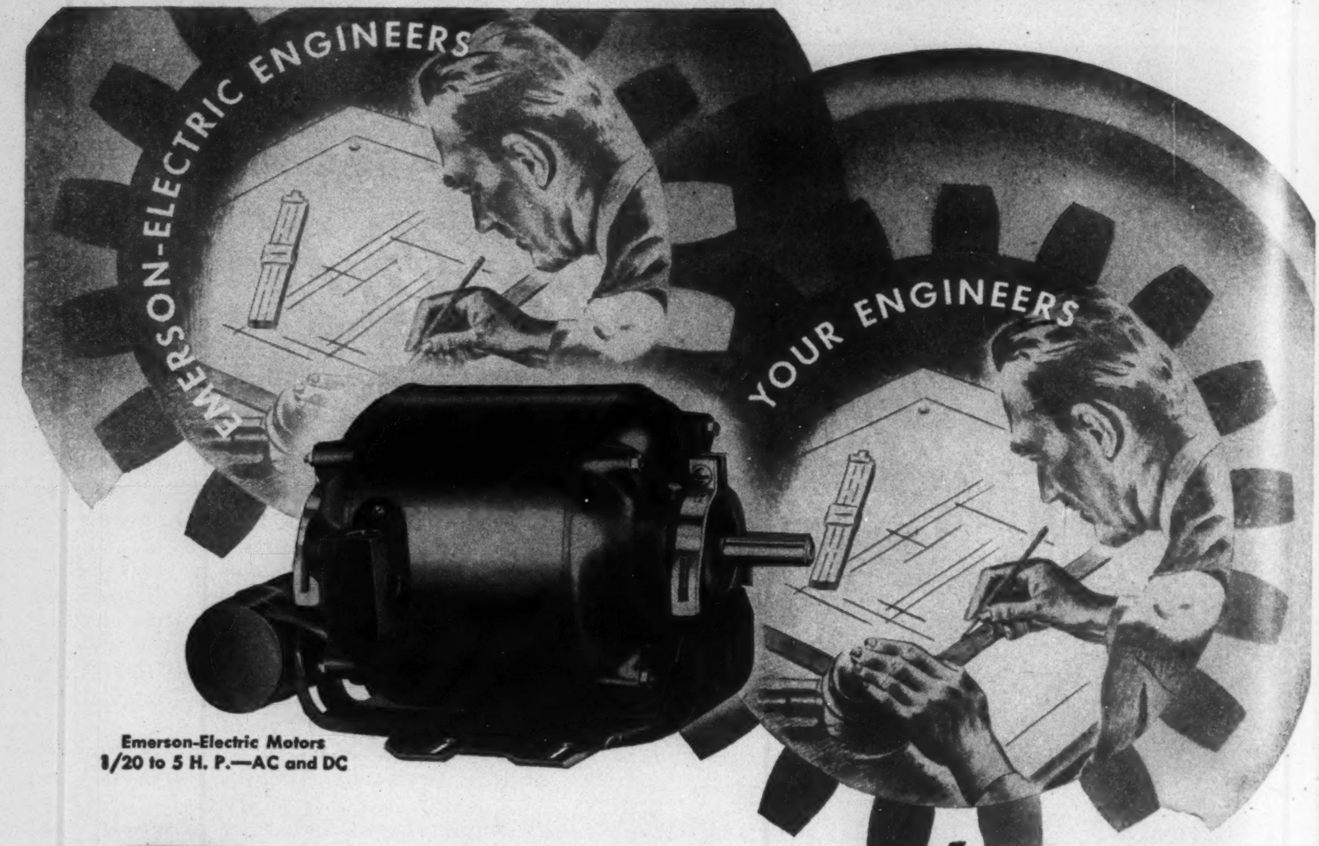
POWER
Dayton
V-BELT DRIVES

V-BELT BUYERS! **A leading mill supply house near you stocks Dayton V-Belts..**
Look for the name in the yellow pages of your telephone directory

Dayton Rubber

THE NAME OF [illegible] IN NATURAL AND SYNTHETIC RUBBER

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS



Emerson-Electric Motors
1/20 to 5 H. P.—AC and DC

Twin-gineered

...TO MESH WITH YOUR PRODUCT

THE *right* kind of power for the *right* kind of product can be accomplished by "meshing" our effort with yours.

When *your* engineers collaborate with *Emerson-Electric* engineers three things may happen . . :

- You save costly engineering back-tracking and obtain the most efficient type of motor for each application.
- You effect production savings through the most practical application of the power unit.
- Your new product reaches the market properly equipped to provide the competitive edge so necessary for profitable merchandising.

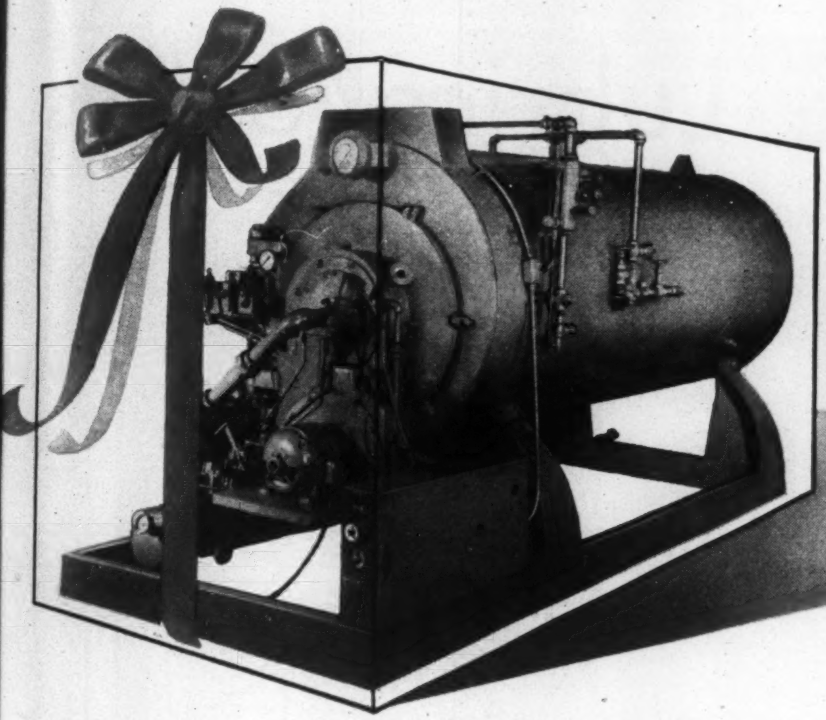
If you are planning a new or improved motor-driven appliance, take advantage of Emerson-Electric's 57 years of engineering experience. Such collaboration—"Twin-gineering," we call it—is yours for the asking.

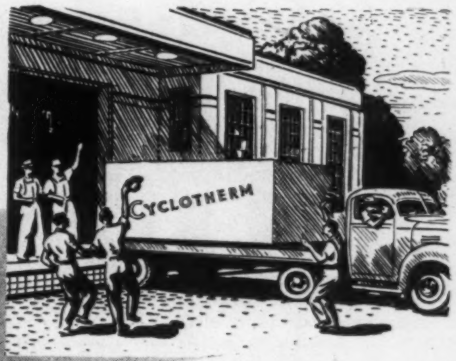
Suggest to your Chief Engineer that he "Call in Emerson-Electric." Write TODAY.

THE EMERSON ELECTRIC MFG. CO.
St. Louis 21, Mo.

Branches: New York, Chicago, Cincinnati, Detroit, Los Angeles and Davenport
55

EMERSON EMERSON ELECTRIC **ELECTRIC**
MOTORS · FANS **APPLIANCES**





The Cyclotherm* steam boiler is delivered to you as a complete, compact unit. All parts are fully assembled and ready for operation upon arrival after making four connections —electricity, fuel, water and steam.

A packaged steam boiler for Space Heating

Cyclotherm patents control a combustion principle that burns fuel *completely* in the first pass of a two-pass boiler. The fuel is first atomized and then burned in a rapidly revolving, highly radiant cyclone of flame which advances slowly through the length of the furnace tube so that the heat is radiated intensely and uniformly. By converting fuel into the maximum amount of steam, Cyclotherm enables you to save part of your fuel dollar.

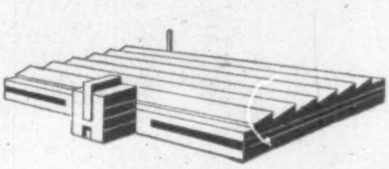
Cyclotherm units operate at 80% efficiency. Conducive to this efficiency, Cyclotherm steam boilers of 80 to 300 HP are equipped with an automatic modulating steam pressure control system which regulates the volume of the flame in response to steam requirements. Firing rates are modulated from 30% to 100% of rated capacity. Units of 10 to 60 HP operate "on-and-off", immediately responsive to thermostat or pressure control, a method equally economical on small boilers.

Cyclotherm will burn gas (natural and manufactured) or oil (from furnace to bunker). Combination units are also available which can be fired with either oil or gas.

Cyclotherm units are manufactured in 13 sizes which range from 10 to 300 HP with operating pressures from 15 to 200 psi. The steam output range is from 345 lbs. per hour, (from feed water at 212° F) to 10,390 lbs. per hour. If your steam requirements are greater, a battery of two or more Cyclotherms is recommended. Batteries up to eight Cyclotherms are now giving highly satisfactory service.

For further information write for our specially prepared booklet 605Z.

POWER


PROCESSING

HEATING

CYCLOTHERM* STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, NEW YORK 4, N. Y.

*"Cyclotherm"—the registered trade mark of products of Cyclotherm Corporation

"Positive Lubrication"

Another Reason Why You'll Make More Profits With the

CURTIS

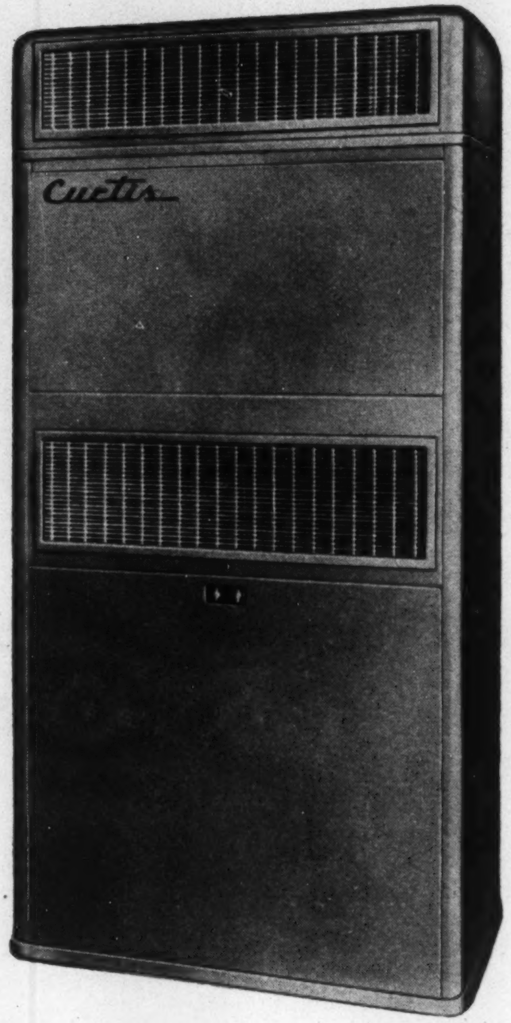
REFRIGERATING AND AIR CONDITIONING LINE

The patented Curtis "Centro-Ring," self-oiling system of positive pressure lubrication assures longer life and lower maintenance for Curtis Condensing Units and Air Conditioners. This is only one of many reasons why the Curtis line is easier to sell and keeps customers sold—making Curtis a more profitable line for you.

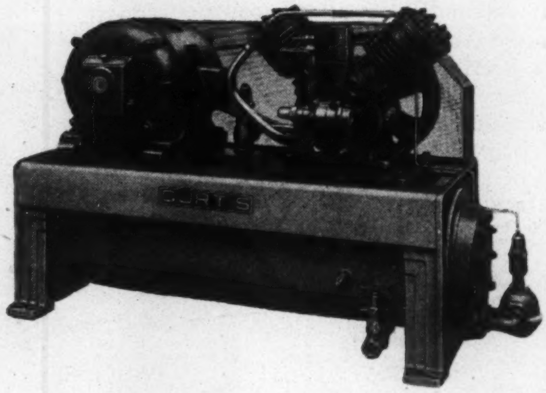
Other Curtis advantages include:

1. Timken Bearings.
2. Extra large condensers.
3. Slow speed operation—quiet performance.
4. Finest materials—precision construction.
5. Full range of sizes and capacities.

Write for full information on the complete Curtis line of Refrigeration and Air-Conditioning equipment.



Curtis Self-Contained Air Conditioners—3, 5, 7½, 10 and 15 tons.



Curtis Condensing Units—¼ to 30 H.P. Air and Water cooled.

CURTIS
REFRIGERATING MACHINE DIVISION
of Curtis Manufacturing Company
1950 Kienlen Ave., St. Louis 20, Missouri

93 Years of Precision Manufacturing

AB-572

You Can Forget About Atmospheric Hazards

This 5 horsepower Century motor operates a conveyor in a grain elevator in an atmosphere charged with explosive dust.

Because this Century 200 horsepower motor operates a blower in the boiler house of a large generating plant it is *protected from falling objects* and dripping liquids.

When You Have a CENTURY Protected Motor ...*Properly Applied*

In this installation the 15 horsepower Century motor is *totally enclosed fan cooled* because it operates in an atmosphere charged with corrosive fumes that would attack the vital parts of the motor.

WITH the correct Century motor driving your machine you can have complete confidence that it will provide a long life of satisfactory performance.

From the wide range of standard types and sizes there is a Century motor that will meet the electrical characteristics and atmospheric conditions of nearly every application.

The three examples shown here each require a different kind of motor frame because of the differences in surrounding conditions. In addition to the fact that all three are powered by Century motors — they have other things in common. They are quiet starting, and they run smoothly and quietly due to their unusual freedom from vibration. They have the correct electrical characteristics to give top performance.

Century builds a complete line of electric motors and generators, fractional and integral horsepower, in the popular sizes to meet the requirements of appliances, industrial production and commercial needs.

Specify Century for all your electric power applications.

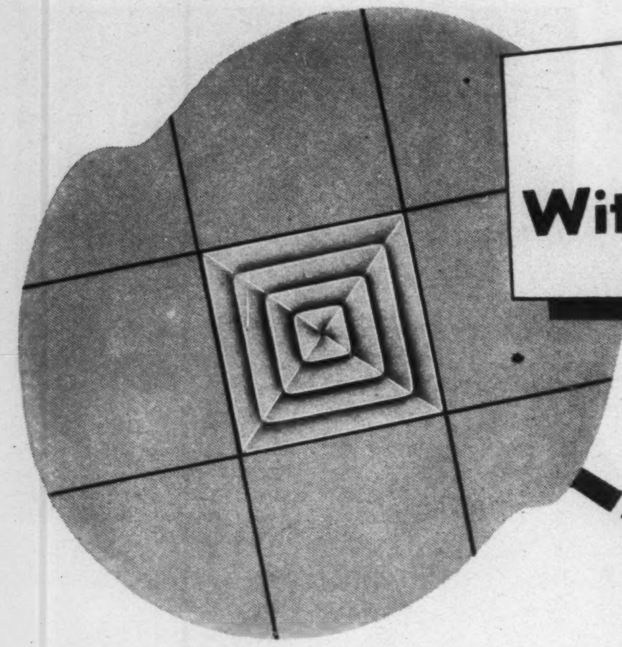
Century
C
MOTORS

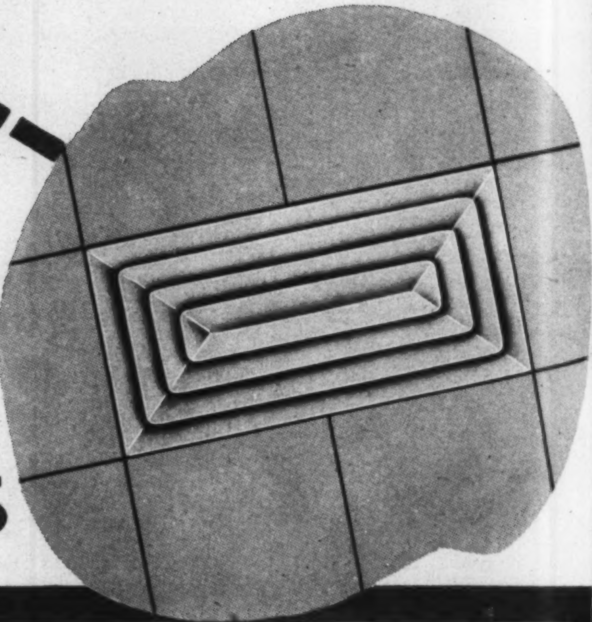
CENTURY ELECTRIC COMPANY • 1806 Pine Street • St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

520

How To Cut Costs Without Cutting Corners





AGITAIR TYPE R

The Only Air Diffuser Especially Designed for

ACOUSTICAL CEILINGS

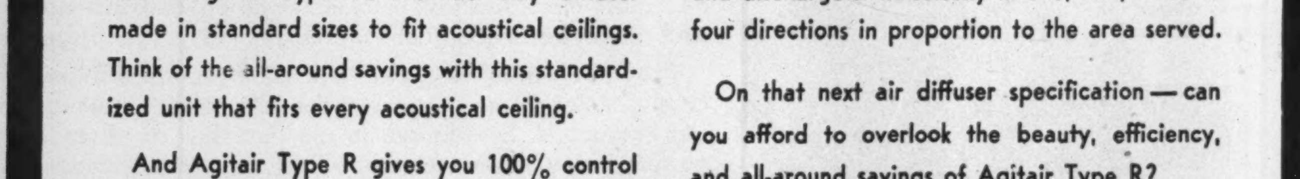
Acoustical Tile, Perforated Steel, or Glass Brick ceilings? Then specify the logical air diffuser—Agitair Type R. It's the only diffuser made in standard sizes to fit acoustical ceilings. Think of the all-around savings with this standardized unit that fits every acoustical ceiling.

And Agitair Type R gives you 100% control of air distribution — with no drafts, no blank corners, no hot spots, no cold spots. Patented construction permits Agitar Type R to be assembled into numerous patterns which divide the air and discharge it noiselessly in one, two, three or four directions in proportion to the area served.

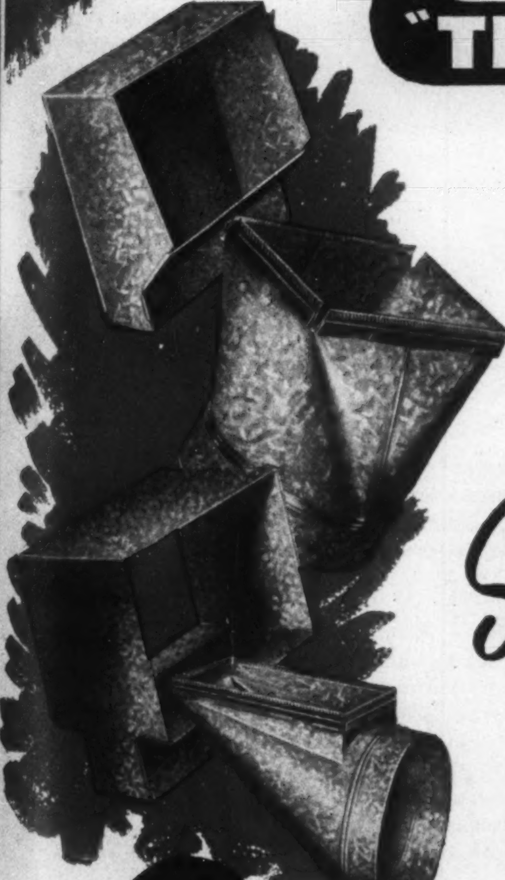
On that next air diffuser specification — can you afford to overlook the beauty, efficiency, and all-around savings of Agitair Type R?

Write for Complete Data

AT 3 KEY POINTS IN AIR CONDITIONING—AGITAIR SERVES BEST



AIR DEVICES. INC. · 17 EAST 42nd STREET · NEW YORK 17, N. Y.



"THEY REALLY FIT!"

C&L-Lamneck fittings are made to standard sizes and manufactured with precision machinery. All fittings are gauged to size and checked for accurate fit by experienced inspectors.

The complete gravity line is now being supplied. The 700 system for forced air is complete, except for plenum chamber, trunk and large trunk fittings.

Specify **C&L-LAMNECK FROM YOUR JOBBER**

Our latest catalog and name of your nearest C & L jobber will be sent on request.

CLAYTON & LAMBERT MFG., CO.
1762 DIXIE HIGHWAY
LOUISVILLE 10 KENTUCKY

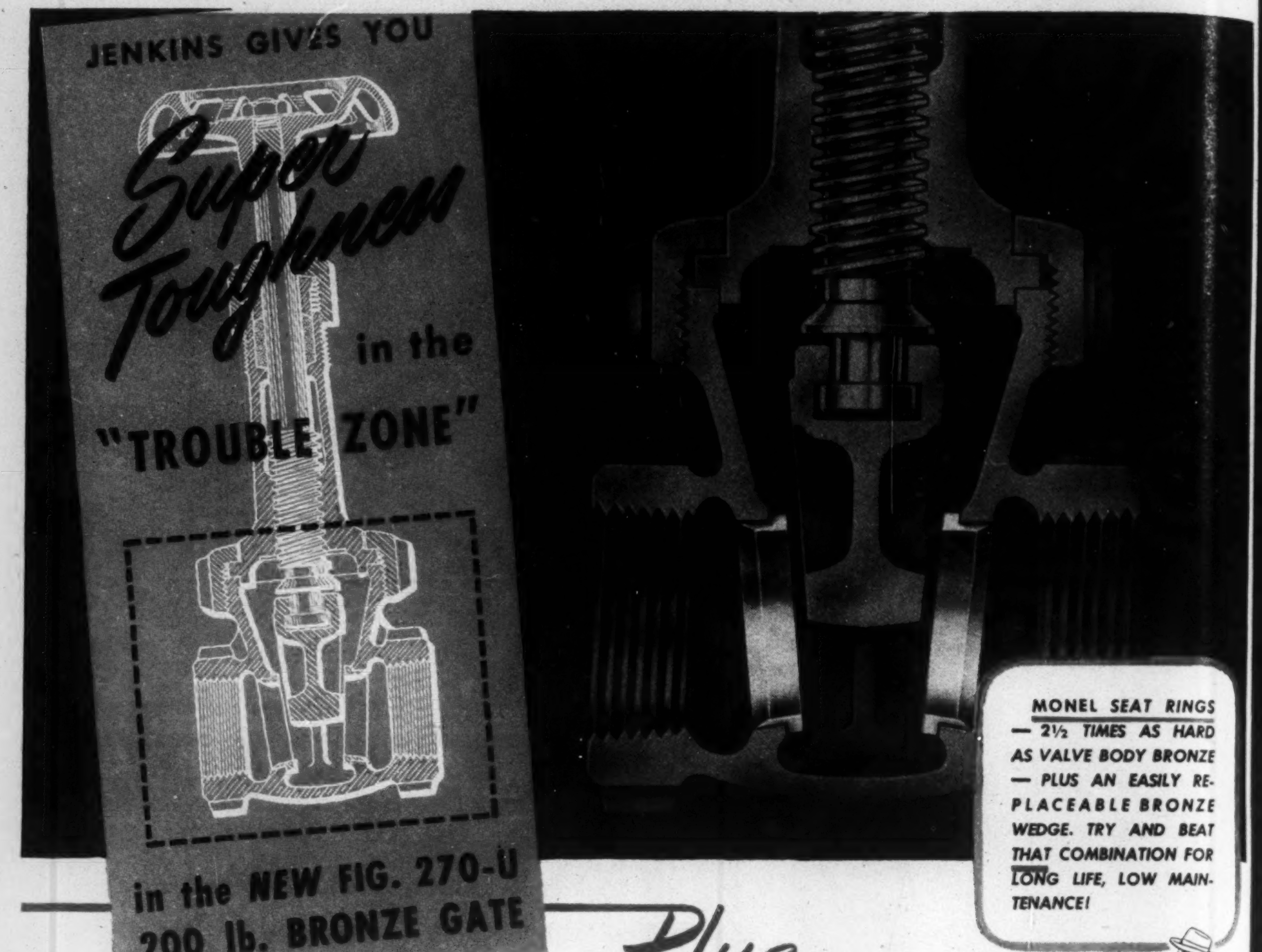
OTHER C&L PRODUCTS: C&L-Blow Torches, Fire Pots; C&L-Hoffman Water Heaters; C&L-Monarch Builders Finish Hardware; Buckeye Corn Cribs, Grain Bins; Silver Shield Silos.

C&L

Lamneck

TRADE MARK

FURNACE PIPE AND FITTINGS



MONEL SEAT RINGS — 2½ TIMES AS HARD AS VALVE BODY BRONZE — PLUS AN EASILY REPLACEABLE BRONZE WEDGE. TRY AND BEAT THAT COMBINATION FOR LONG LIFE, LOW MAINTENANCE!

Plus....

IN the NEW Fig. 270-U Bronze Gate Valve, Jenkins engineers give you a practical design to checkmate trouble in the "trouble zone" — and cut maintenance to a new low.

Wear affects only the most accessible part — the bronze wedge — which can be replaced simply by slipping it off the stem and slipping on a new one. The seat rings, expanded in the body, are super-tough MONEL, for lifetime durability. Convincing tests, in toughest service, prove it the best seating combination to beat wear, reduce care.

Get complete details of this NEW Jenkins Fig. 270-U. See why it's your best buy in a 200 lb. Bronze Gate, especially for unusually severe conditions, such as in oil refineries, chemical, food, and rubber plants.

LARGE SPINDLE THREADS—Plenty of large diameter, sturdy threads reduce wear to a minimum, insure easy operation.

EXCEPTIONALLY RUGGED BODY, BONNET, AND BONNET RING — Withstand rough usage, shocks and hydraulic pressure far beyond rating.

DEEP STUFFING BOX — MORE PACKING—Keeps packing tight around spindle with less friction, permits spindle to be turned with less effort.

NEW FOLDER — Describes many other exclusive features that mean extra years of low-cost performance.

WRITE FOR THIS FOLDER. It describes the Fig. 270-U and many other popular Jenkins Bronze Gate Valves. Or, ask your Jenkins Distributor.

MAIL THE COUPON TODAY

Jenkins
BRONZE GATE VALVES

LOOK FOR THIS DIAMOND MARK

SINCE Jenkins Bros 1864

JENKINS VALVES

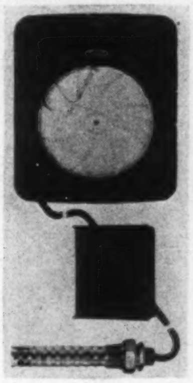
Types, Sizes, Pressures, Metals for Every Need

JENKINS BROS.,
80 White St., New York 13, N. Y.
Send Bronze Gate Valve Folder.
NAME..............................
COMPANY..............................
ADDRESS..............................

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1947 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Dew Point Recorder Measures Equilibrium Temperatures



No. 3625—Dew point recorders and recording controllers, of the continuous dew point measuring type, are the newest additions to the line of industrial instruments offered by Foxboro Co., Foxboro, Mass.

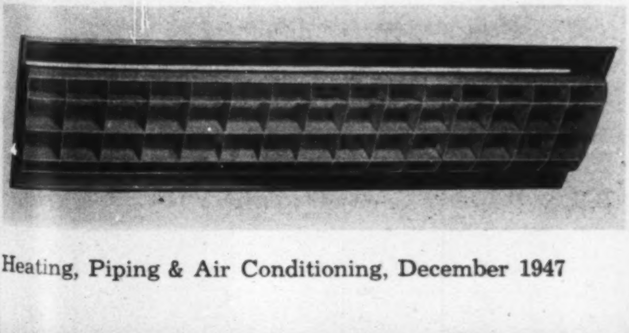
The unique feature of the equipment is said to be the company's patented measuring element, the "Dewcel." It has the general appearance of a perforated metal cylinder about 9 in. long and 2 in. in diameter. Within is a central tube containing the thermal bulb, wrapped with a saline saturated woven glass tape and two windings of silver wire, to conduct the heating current. Moisture determination is based on the fact that for every water vapor pressure in contact with a saturated salt solution there is an equilibrium temperature at which the solution neither absorbs nor gives up moisture to the atmosphere. The function of the variable heat supply is to bring the measuring element to this equilibrium temperature. This temperature, measured by the thermal bulb, is transmitted to the recording instrument, and is read on the chart in degrees of dew point temperature. Recording is continuous. Various standard chart ranges are available, two of the most common being −20 F to 92 F dew point and 36 to 160 F dew point.

Two types of recorders are offered. One is the "Dynalog" all-electronic instrument; the other is the liquid filled system type. Pneumatic or electric control systems, for the operation of valves, dampers, or motors, can be supplied in either instrument.

Line Type Air Distribution Outlet Includes Lighting Unit

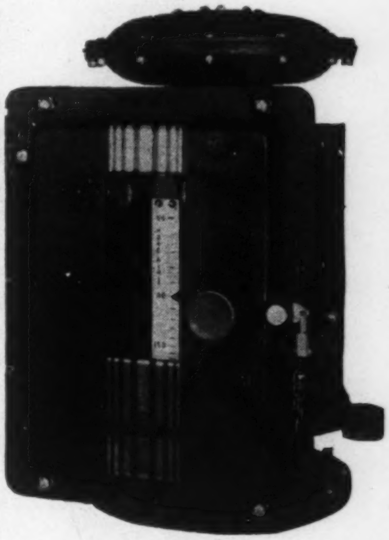
No. 3626—"Line-O-Flo" air distribution ceiling outlets, which can be used with fluorescent lighting units as an integral part of the assembly, have been developed by Barber-Colman Co., Rockford, Ill.

Air discharge openings of the units are designed to simulate venturi throats with bellmouth approaches. Stratification and objectionable drafts are said to be eliminated by high diffusion efficiency and rapid induction of room air into the primary air stream. Features include the use of a gasket around the edge of the ceiling flange and adjustable balancing dampers above the outlet throat, designed to control air volumes and insure uniform distribution over the entire length of the unit.



Two models, in three styles each, are available and may be used either as supply or return units. One model, the LL, has been designed to receive the M21118 fluorescent light unit manufactured by Day-Brite Lighting, Inc., St. Louis, Mo.

Controls Air-Fuel Ratio



No. 3627—A new air-fuel ratio controller designed for simplicity, accuracy, and sensitivity has been announced by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. Like the "Micromax" pyrometers and the company's furnace pressure controllers with which it operates, this unit employs electric-motored valve drives.

It is a balance type instrument, said to have ample flexibility to meet any operating condition. Its ratio can be adjusted manually for operation with fuels of various Btu content. As fuel flow changes, the instrument is said to maintain air-fuel ratio constant at the desired control point. Or, it can provide automatic variation of ratio, increasing or decreasing the percent of air at reduced fuel flows.

(Continued on page 182)

Heating, Piping & Air Conditioning **[12-47]**
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

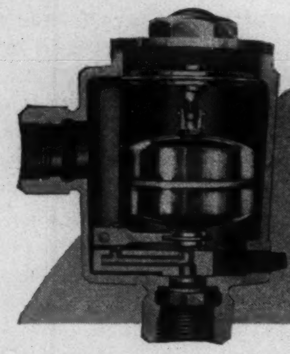
3625 3626 3627 3628 3629 3630 3631 3632 3633 3634
3635 3636 3637 3638 3639 3640 3641 3642 3643 3644
3645 3646
6693 6694 6695 6696 6697 6698 6699 6700 6701
6702 6703 6704 6705 6706 6707 6708 6709 6710 6711
6712 6713 6714 6715 6716 6717 6718 6719 6720 6721
6722 6723 6724 6725 6726 6727 6728

Name.............................. **Title**..............

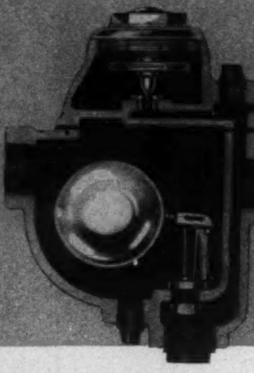
Company ....

Address ....

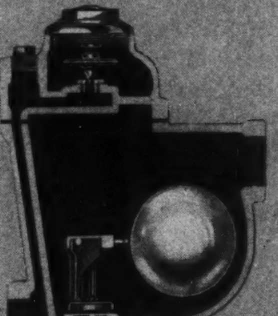
City.......................... **Zone**...... **State**...........



Marsh No. 17 Float and Thermostatic Trap for removal of air and condensate from short steam mains, branches and risers. Ideal for installation on unit ventilators and small unit heaters.



Marsh No. 12 Drip Trap — a float and thermostatic trap of larger capacity than the No. 17. Unit heaters, steam coils, etc. are within the capacity range of this trap.



Marsh No. 8 Drip Trap — a float and thermostatic trap larger than the No. 12 for quick removal of air and condensate from drip points on steam mains, coils, blast heaters and similar services. Still larger traps are available for heavy duty service.

...Only the best traps are good enough

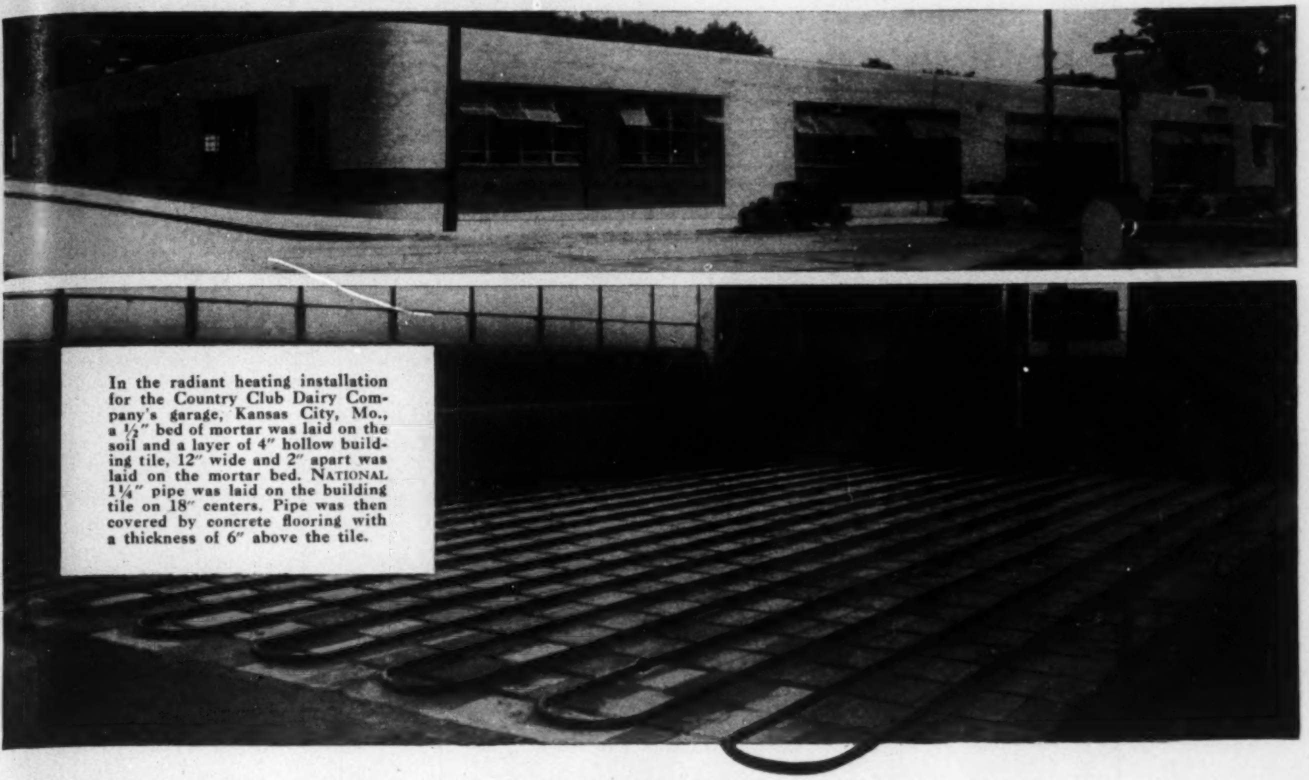
Probably more otherwise good heating systems have been ruined by ineffective traps than can be charged against any other kind of equipment. Experienced heating men know this. They know that only the best trap is worthy of the vital job of keeping the system free of air and condensate, and to hundreds of heating men that means Marsh.

Three widely used, fully proved Marsh Float and Thermostatic Traps are illustrated here. They cover a wide range of applications for traps of this type in systems with working pressures up to 15 lbs. An outstanding feature of all of them is the Marsh Thermostatic diaphragm for venting air—a highly perfected unit which makes a particularly fine distinction between steam and heated air, so that air is properly removed without permitting steam to escape. The float operated valves in these traps are precision-built to give positive discharge and tight closure. Any one of the traps may be installed in the piping without other means of support.

Down to the last detail Marsh Traps have been perfected step by step across the years. They are *your kind* of traps: Well designed, well made, functional, practical. Years of practical experience have shown us how to apply these traps to best advantage in all types of systems. Ask for recommendations covering your particular needs.

MARSH HEATING EQUIPMENT COMPANY
DEPT. T, SKOKIE, ILLINOIS
Division of Jas. P. Marsh Corp.

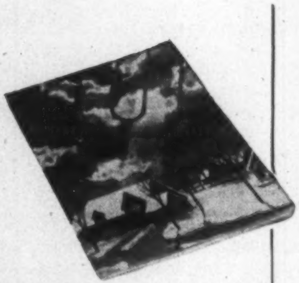
MARSH
Quality Heating Specialties
SINCE 1865



In the radiant heating installation for the Country Club Dairy Company's garage, Kansas City, Mo., a ½" bed of mortar was laid on the soil and a layer of 4" hollow building tile, 12" wide and 2" apart was laid on the mortar bed. NATIONAL 1¼" pipe was laid on the building tile on 18" centers. Pipe was then covered by concrete flooring with a thickness of 6" above the tile.

Planning a radiant heating installation?

. . . make sure the pipe is NATIONAL



This 48-page book brings you an easy to understand story on radiant heating and gives you practical information as a basis for planning and installing an efficient pipe system. It will answer many questions about radiant heating that you may have. For your free copy address: National Tube Company, Frick Building, Pittsburgh, Pa.

COLD floors, so detrimental to garage personnel, have been successfully eliminated in this Missouri dairy garage by radiant heating. It has also eliminated hot and cold temperature zones . . . minimized the chilling caused by door openings . . . provided a larger working area.

Steel pipe is ideal for radiant heating installations just as it is ideal for other hot water or steam heating systems. It expands at the same rate as concrete and plaster; it is easy to weld, easy to bend, and, with its maximum of advantages, costs less.

NATIONAL, the leader in steel pipe for many years, offers the additional advantages of the Scale Free and Spellerizing Processes. These processes mean that the pipe interior is clean, smooth, free from mill scale, with minimum frictional resistance. They also mean superior corrosion resistance, and increased weld strength through extra rolling.

For detailed information on the use of NATIONAL Pipe in radiant heating installations, write for Bulletin—"Radiant Heating with NATIONAL Pipe." Address National Tube Company, Frick Building, Pittsburgh, Pennsylvania.

NATIONAL TUBE COMPANY USS STEEL UNITED STATES STEEL

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

ALDRICH HEAT-PAK PRODUCTS

BOILER-BURNER UNITS

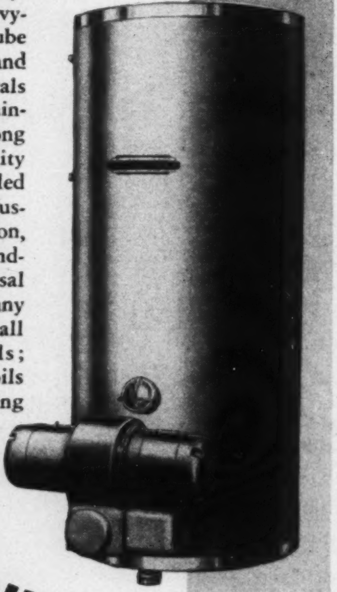
in

6 Sizes

FOR DOMESTIC, COMMERCIAL AND INDUSTRIAL USE

- HOT WATER HEATING
- STEAM HEATING
- HOT WATER SUPPLY

Here is a line of Boiler-Burner Units that will take care of practically any requirement — from a small water heater for a residence to a heating installation in an industrial plant, and including many processing applications. A dealer offering Aldrich products can supply units with any capacity from 85,000 to 808,500 BTU per hour. Aldrich Boiler-Burner Units are quality-built throughout — extra-heavy-gauge steel, vertical, fire-tube boilers, accurately welded and thoroughly tested; built-in spirals that reduce sooting and help maintain maximum efficiency for long periods; matched, high-quality Aldrich Burners, factory-installed and wired, complete with combustion chamber; thick insulation, properly installed under a handsome sheet-metal shell; universal tapping, fitting any model for any service; suitable gauges, and all necessary automatic controls; spiral copper water-heating coils in specified models of heating boilers. With all these quality features to offer at competitive prices, any Aldrich dealer should do *good business.*



ALDRICH OIL BURNERS

The widely-favored, skilfully-engineered, dependable Aldrich Burners are made in 3 types and 5 models with capacities ranging from .75 to 19 gph — a range sufficient to handle practically any oil-burning demand.

ALDRICH COMPANY

WRITE TODAY FOR COMPLETE DATA AND PRICE LISTS . . .

OIL BURNERS • BOILER-BURNERS FOR HEATING AND DOMESTIC WATER SUPPLY

105 EAST WILLIAMS ST., WYOMING, ILL.

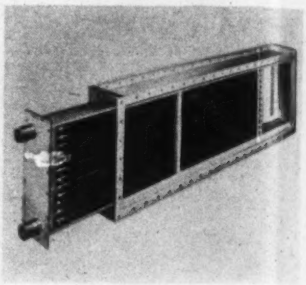
(Continued from page 179)

Air Compressor Safety Valve Has Nylon Disc

No. 3628—Manning, Maxwell & Moore, Inc., Bridgeport 2, Conn., has developed a new safety valve for air compressors, utilizing a nylon disc.

The valve is provided with a stainless base and cadmium plated cap and spring. The use of nylon as a material for safety valve seats is said to be new, and according to the manufacturer, it provides all the essential characteristics of wear resistance, hardness, and flexibility. The disc works against a bronze seat.

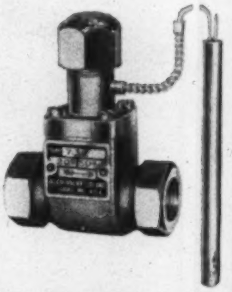
Copper-Nickel Tubes Used In Heavy Duty Steam Coils



No. 3629—Type H heavy duty steam coils for industrial and process heating have been announced by American Blower Corp., Detroit 32, Mich. Available in a wide range of sizes, these coils are designed for steam pressures up to 300 psi, for all high pressure continuous duty blast air heating applications, and for corrosive conditions.

Copper-nickel tubes with copper fins are used, and the heating element is removable from the air tight casing. The tubes may be replaced in the heating element by means of heavy duty couplings; no welding or brazing is required.

Automatic Suction Valve Controls Refrigerant Temperature



No. 3630—A new snap action suction valve, type 732, has been developed by Alco Valve Co., St. Louis, Mo., to provide refrigerant temperature control in a single unit.

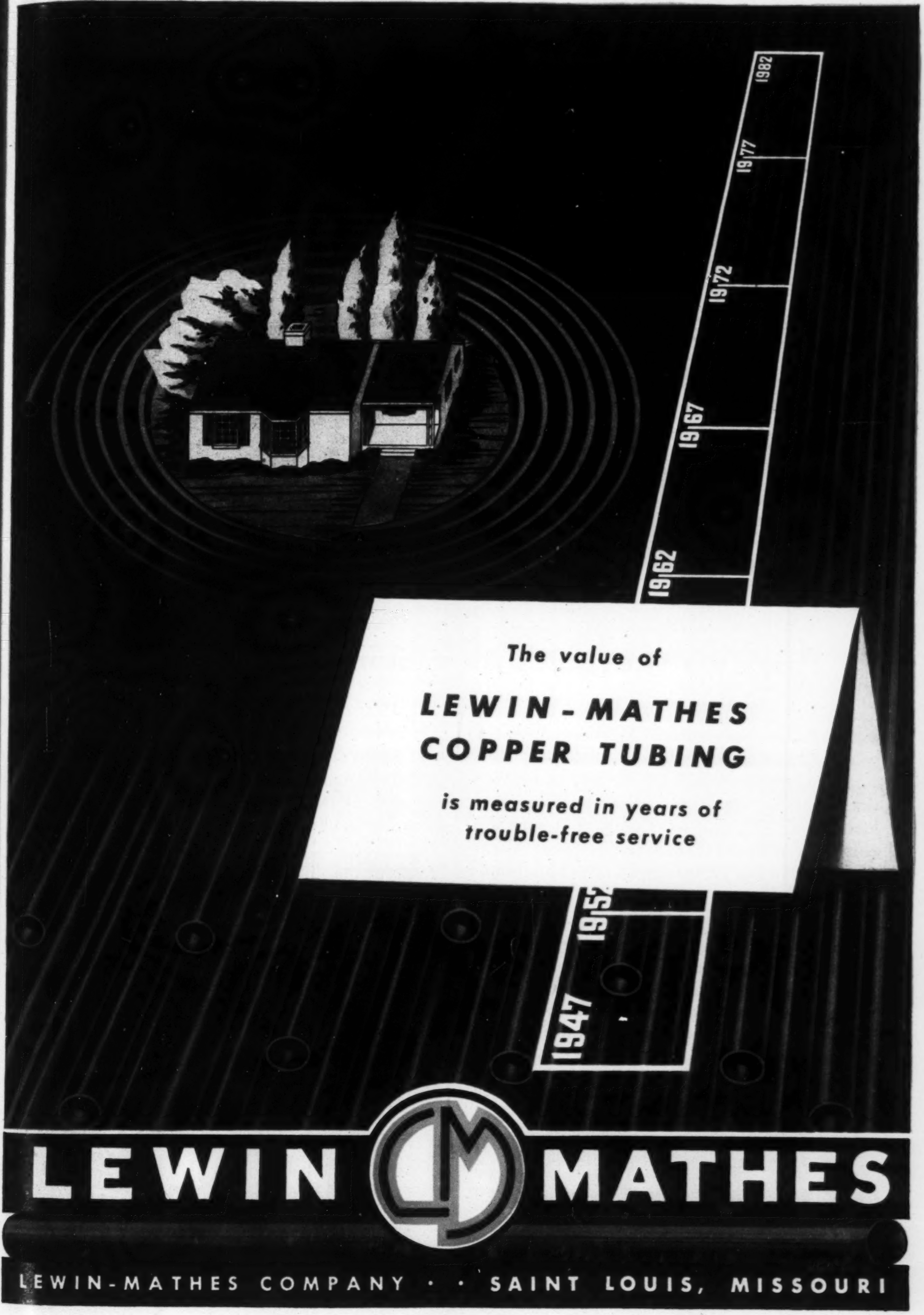
The valve responds directly to actual load temperatures and does not require electrical wiring or accessories. It is installed in the evaporator suction line and a remote or feeler bulb is located in the same way as a thermostat bulb. Automatic defrosting is obtained on the off cycle where the temperature is above freezing, and the narrow temperature differential is said to minimize frost build-up by reducing the running or on periods.

Nominal valve capacity is ½ ton, "Freon-12" or ¾ ton, methyl chloride. Line connections, both inlet and outlet, are ½ in. FPT.

Uses Interchangeable Inner Valves in Control Valves

No. 3631—A line of restricted inner valves, used in control valves offered by Fisher Governer Co., Marshalltown, Iowa, has recently been announced.

When used with the company's interchangeable, reduced trim, double-ported flow control valves, the valve port area may be changed by installing a new inner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1952
1947
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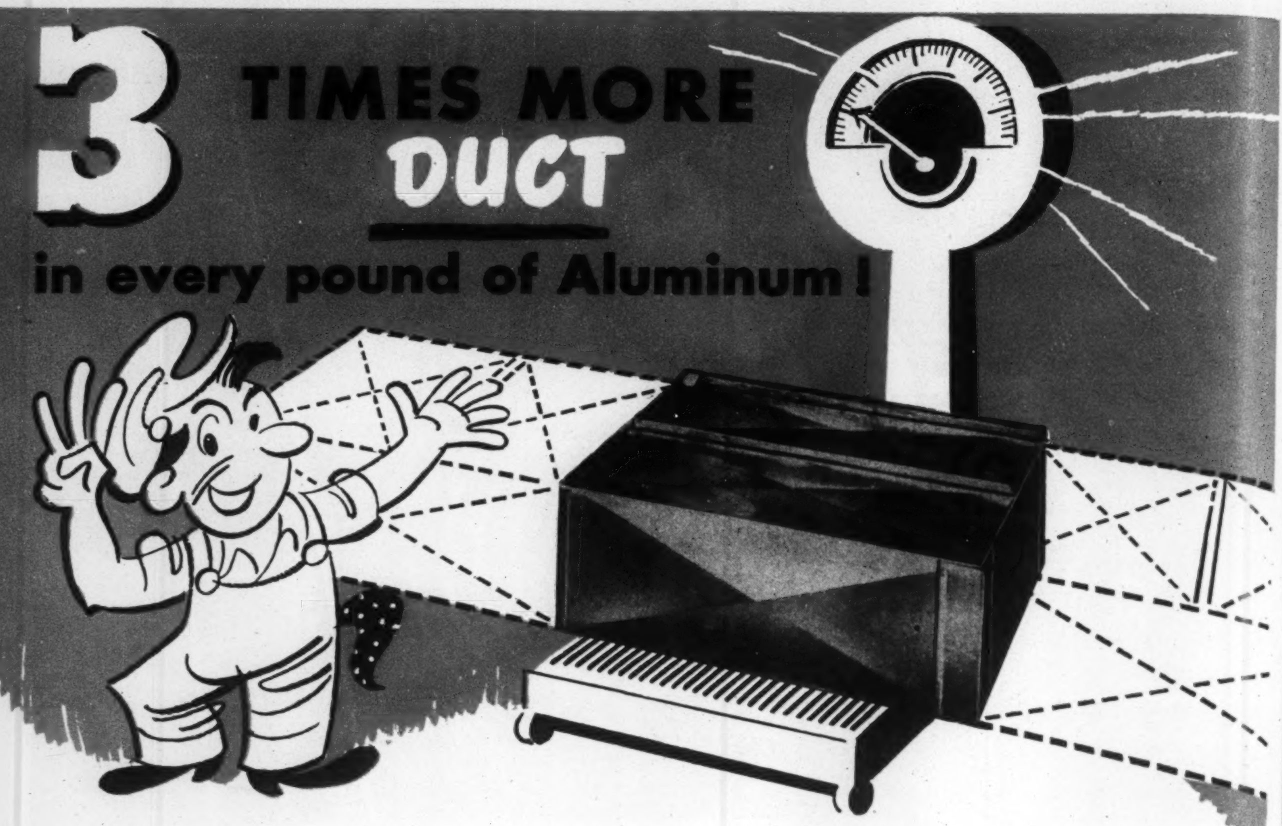
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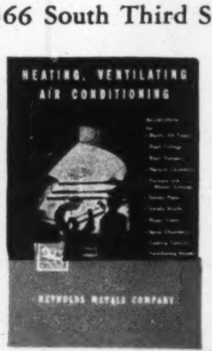
And that's just the beginning. This lightweight Reynolds Aluminum Utility Sheet saves you time and money both in shop fabrication and erecting on the job. What's more you deliver a finished installation of highest quality. Aluminum ducts require no paint, look better, are rust-proof and corrosion resistant and assure greater heating efficiency with quieter operation.

For complete information on Reynolds Aluminum Utility Sheet for ducts contact your nearest jobber, Reynolds Sales Office or write direct to Reynolds Metals Company, Aluminum Division, 2566 South Third Street, Louisville 1, Kentucky.



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YOU KNOW IT'S NOT
ALUMINUM

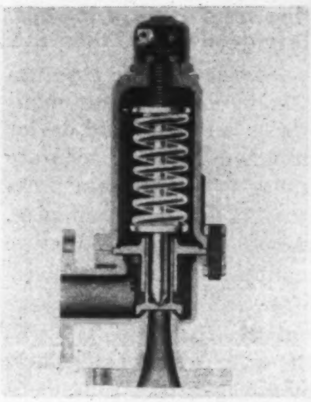
REYNOLDS ALUMINUM

REYNOLDS METALS COMPANY

THE GREAT NEW SOURCE OF ALUMINUM

valve without changing the seat rings. This, says the manufacturer, offers advantages in meeting increased capacity requirements due to plant changes, etc., in correcting hunting and poor control where the cause is oversize valves, and in providing proper control in those installations, such as in power plants, where line stresses may be high and where full line size valves are used for strength requirements but are not necessary from the flow control standpoint.

Safety and Relief Valve Resists Acids



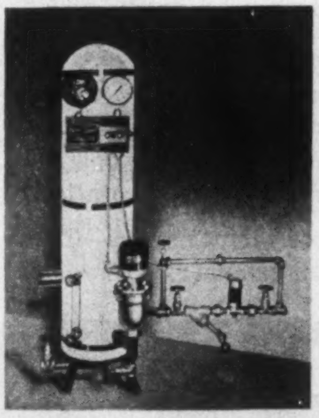
No. 3632—Farris Engineering Corp., 494 Commercial Ave., Palisades Park, N. J., has developed a line of corrosion resistant safety and relief valves designed principally for the process and petroleum industries.

Outstanding reductions in maintenance costs for installations handling corrosive gases and vapors are said to be accomplished by the use of a nickel-iron alloy containing molybdenum, silicon, and copper for the inserted nozzle and valve disc, and in certain models, for the complete valve body, together with the complete isolation of all working parts behind a vaporproof "FarriSeal" curtain. The alloy used is "Hastelloy-C", manufactured by Haynes Stellite Co., and the protective seal of rubber, neoprene, or any suitable flexible metal is attached to the disc at one end and the flanged disc guide at the other.

Other advantages are said to include the use of the nozzle throat, the high disc lift which is designed to permit full capacity discharge, a long-stressed, protected loading spring, precision alignment of spring and disc, and a top-loaded, free acting disc guide.

Valves are available with flange connections in sizes from ½ to 2 in.; with screwed connections in sizes from ½ to 1 in.

Develops Heating and Drainage System for Steam Heated Equipment



No. 3633—The "Quik-Temp" heating and drainage system for steam heated equipment has recently been developed by Fred H. Schaub Engineering Co., Inc., 2110 S. Marshall Blvd., Chicago 23, Ill.

The main purpose of the system is to provide quicker heating of equipment and higher sustained operating temperatures at any given steam pressure. Large diameter metering units are installed in return lines in lieu of conventional traps. A liquid seal of water over the main condensation discharge port near the bottom of the accumulator is

• • WATER FOR CANADA'S FALCONBRIDGE NICKEL MINES

—Twelve miles from Sudbury, Canada in the heart of the rich nickel mining area, two newly completed Layne Well Units are now producing over 3,000 Imperial Gallons of Water per Minute. Started in weather 30 degrees below zero, the two wells were drilled, equipped, tested and delivered without delay. Both wells are electric motor powered and are providing water for the mines and for the townsite. Ore from these mines is shipped to Norway for refining.

Layne Well Water Systems are widely used throughout Canada, serving cities, mines, paper pulp mills, air fields and army camps. As is the case elsewhere, these Canadian installations are highly efficient, produce large quantities of water and are exceptionally dependable in all kinds of weather.

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- **pumps** for wells, lakes, rivers, reservoirs, irrigation —or for any use where large quantities of water must be producer at low cost. Sizes range from 40 to 16,000 gallons per minute. Write for Layne Pump Catalog.

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VERTICAL TURBINE PUMPS

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. * Layne-Atlantic Co., Norfolk, Va. * Layne-Central Co., Memphis, Tenn. * Layne-Northern Co., Mishawaka, Ind. * Layne-Louisiana Co., Lake Charles, La. * Louisiana Well Co., Monroe, La. * Layne-New York Co., New York City * Layne-Northwest Co., Milwaukee, Wis. * Layne-Ohio Co., Columbus, Ohio * Layne-Pacific, Inc., Seattle, Washington * Layne--Texas Co., Houston, Texas * Layne-Western Co., Kansas City, Mo. * Layne-Western Co. of Minnesota, Minneapolis, Minnesota * International Water Supply Ltd., London, Ontario, Canada * Layne-Hispano Americana, S. A., Mexico, D. F.

said to prevent steam passage, reduce flash steam loss, and thus, effect fuel savings.

Shown here is the 8 x 48 in. accumulator designed to handle drainage from as many as 12 machines or units with total consumption up to 30 hp. It is built for working pressures up to 150 psi.

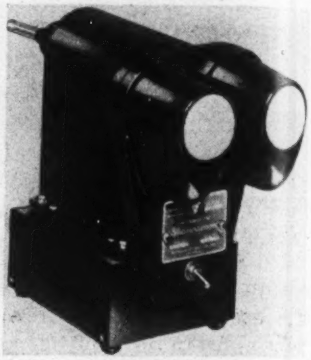
Separate Jacket Water Coolers Used for Oil Drilling Rig

No. 3634—Recently there has been put into operation in California a drilling rig using an installation of jacket water coolers manufactured by Young Radiator Co., Racine, Wis. These are located remotely instead of mounted directly to the engines. The principal objection to the separate coolers in the past has been that they constitute another piece of equipment to be moved every time the drilling rig is moved; however, the company states that there are more than enough advantages to offset this previously considered disadvantage.

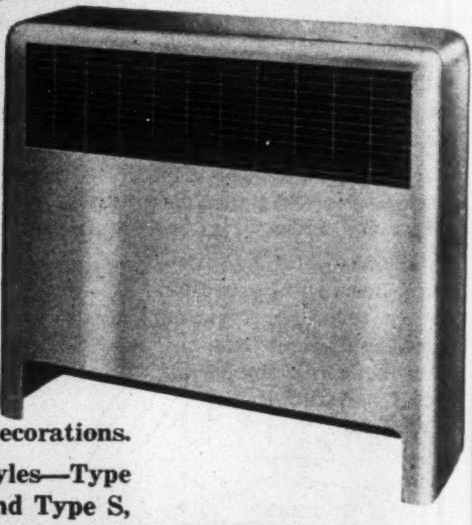
The principal advantage is the power saving in fan loads. Using, for an example, an installation where ten 105 hp engines are used, and assuming 12 hp fan load per engine if fans were on the engines, this releases 112 more hp to apply to the drilling rig, since the separate cooler uses only eight fan horsepower.

The cost of the separate coolers has to be considered in the overall cost consideration, but the cost is said to be largely offset by omission of engine radiators and fans. Other advantages are said to include: (1) removal of a great deal of heat within the rig which is an objectionable feature on engine powered rigs—the engine radiators do not have access to unheated air, frequently at least, and the heat is objectionable to the crews in hot weather, (2) elimination of the noise of high speed fans from the rig, (3) by having water pumps on the separate coolers, a constant flow of water can be distributed to all engines regardless of engine speed and engine pump performance, and (4) the separate coolers can be tied in to the cooling circuit of either the hydromatic or electric drawworks brakes, thus dispensing with a cooling tower or other cooling equipment used for that purpose.

Measures High Vacuums in Refrigeration, Other Systems



No. 3635**—The type Dm "Skanascope" vacuum monitor is an electronic device designed for the accurate indication of vacuum pressures in the 1 to 200 micron range. According to the manufacturer, Skaneateles Mfg. Co., Inc., 122 Dickerson St., Syracuse 2, N. Y., the unit is used extensively by refrigeration equipment manufacturers because in pumping down units the gage measures all condensables, including water vapor. The device is also used in servicing large air conditioning and refrigeration units in the field where equipment has



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AIRTHERM CONVECTORS are available in three cabinet styles—Type F, free standing or partially recessed; Type W, wall cabinet; and Type S, sloping top wall cabinet—in a complete range of depths, heights, and lengths.

Have you recently investigated the advantages of specifying and installing convectors? Write for new bulletin describing AIRTHERM CONVECTORS.

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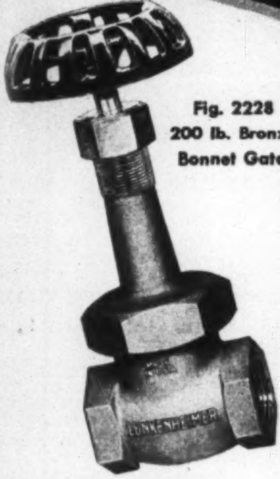

Fig. 2228
200 lb. Bronze
Bonnet Gate

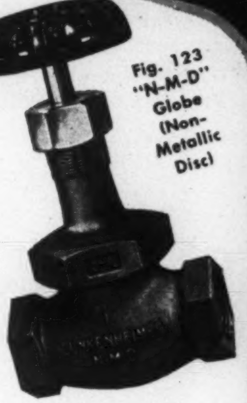

Fig. 123
"N-M-D"
Globe
(Non-Metallic
Disc)

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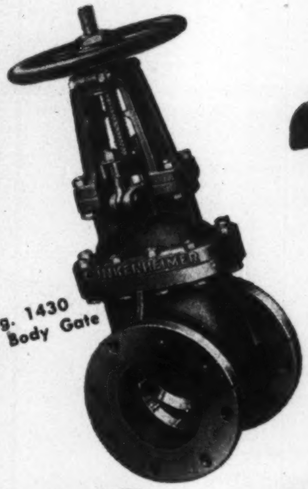


Fig. 1430
Iron Body Gate

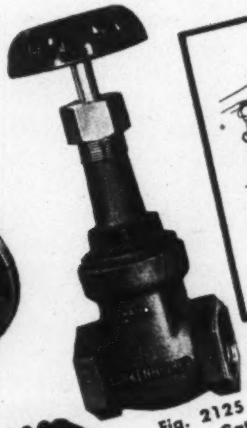
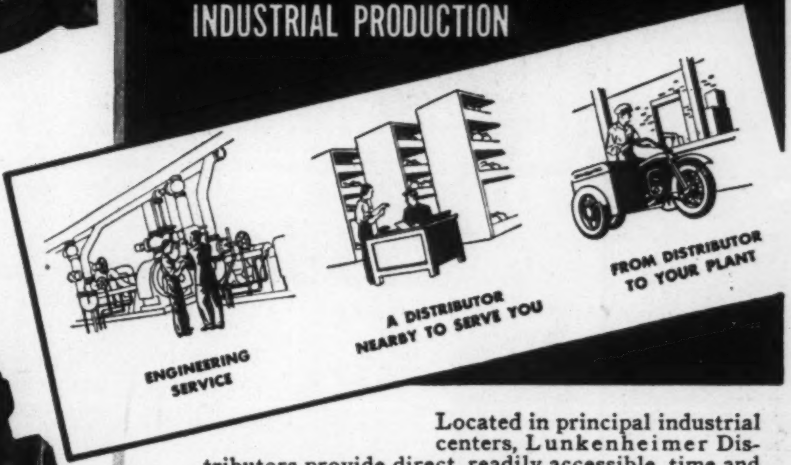


Fig. 2125
Bronze Gate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Located in principal industrial centers, Lunkenheimer Distributors provide direct, readily accessible, time and money-saving service throughout the nation.

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This service is nothing new . . . Lunkenheimer Distributors have been providing it for many years in the past, and will continue doing so in the future. For this established Distributor set-up is a basic, permanent part of the Lunkenheimer way — the *better service* way.

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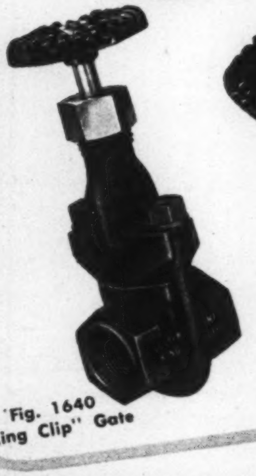

Fig. 1640
"King Clip" Gate

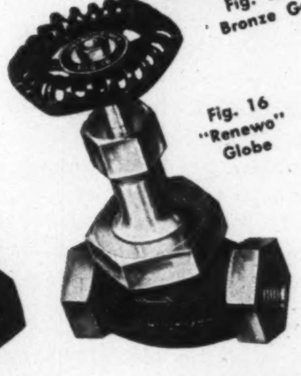

Fig. 16
"Renewo"
Globe

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THE LUNKENHEIMER CO.
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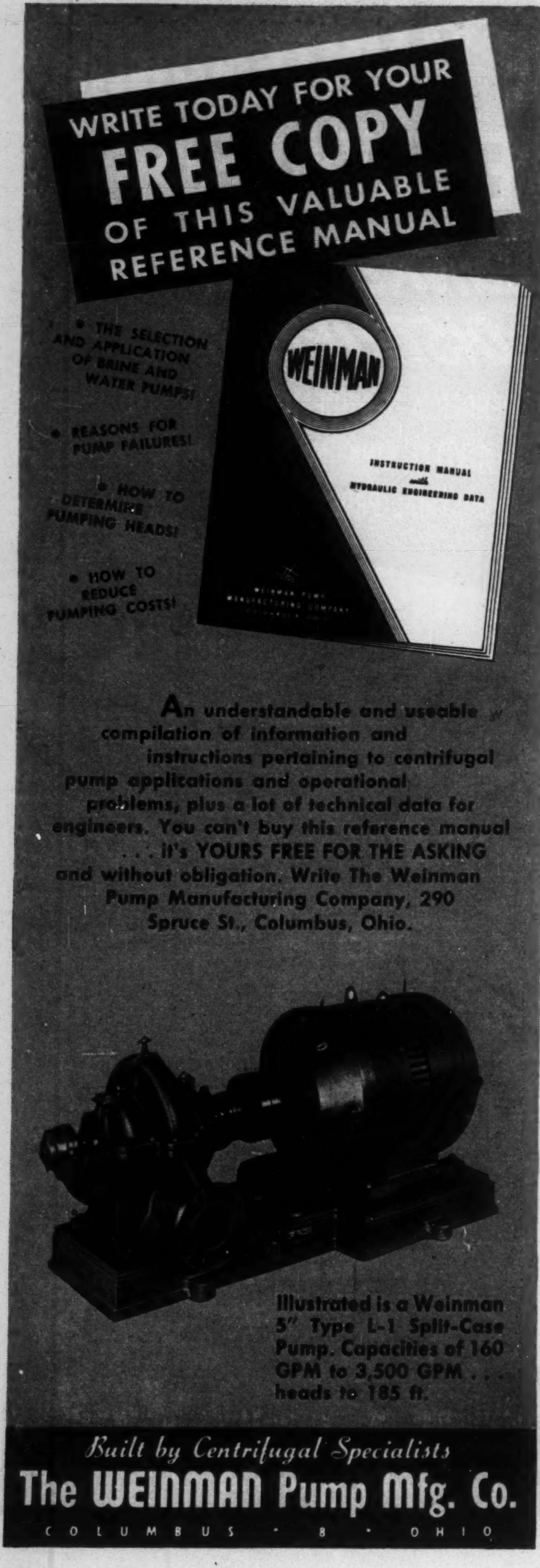
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Illustrated is a Weinman 5" Type L-1 Split-Case Pump. Capacities of 160 GPM to 3,500 GPM . . . heads to 185 ft.

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been opened to the atmosphere and must be pumped down.

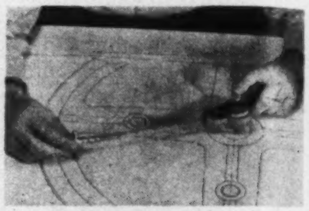
Signals are registered by luminous tube units, connected in series with a pair of gage tubes which in turn, operate a 3 amp inductive load relay for the actuation of external apparatus.

Industrial Oil Burner Has Wide Capacity Range

No. 3636—A new heavy-oil burner of the horizontal rotary type, with a capacity of 5 to 150 gpm, has been announced by Preferred Utilities Mfg. Corp., 1860 Broadway, New York 23, N. Y.

The company's "Voluvalve" and the air-oil control in combination are said to provide an automatic throttle control which assures the maintenance of an accurate combustion mixture throughout the entire range of high-low operation, regardless of the pressure, viscosity, and temperature of the oil. A single, electrically ignited gas pilot is used.

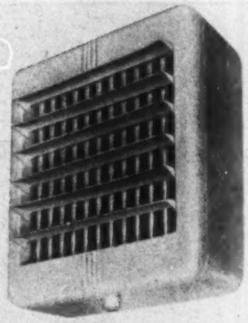
Steel Tape Used in Beam Compass



No. 3637—A beam compass utilizing a retractable steel tape has been developed by Omicron Co., 532 W. Windsor Rd., Glendale 4, Calif. Designed for use in architectural and engineering drawing, sheet metal layout, and for woodworking, the device may be used for radius settings up to 72 in.

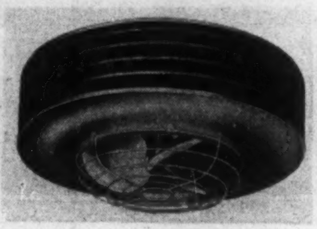
The tape retracts into a small die-cast case, and a brake lever is used to lock the tape in any desired position. Depressing a lever releases the brake. The machined head will hold a standard drafting pencil lead, a steel scriber, or a common lead pencil.

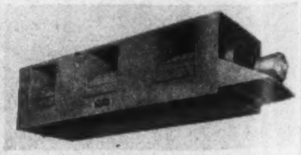
Redesigned Unit Heaters Incorporate New Fins, Tubes



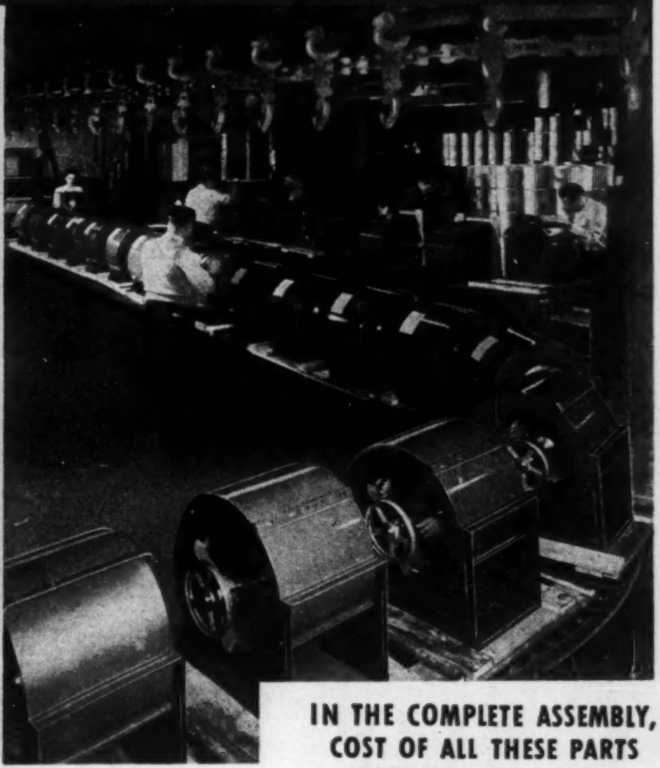
No. 3638—The horizontal, down flow, and blower type unit heaters offered by McQuay, Inc., 1600 Broadway, N.E., Minneapolis 13, Minn., have been redesigned from an appearance standpoint and now incorporate the company's "Ripple Fin" coil construction.

The rippled tubes and fins, says the manufacturer, are designed to provide close adhesion between tubes and fins, proper turbulence of water, steam, or other gases within the tubes, and turbulence in the air passing over the tubes.





Lau Blower mass production methods CANNOT BE MET by small-quantity assemblers



IN THE COMPLETE ASSEMBLY, COST OF ALL THESE PARTS MUST BE CONSIDERED

- Wheel
- Shaft
- Bearings
- Collars
- Washers
- Nuts
- Bolts
- Bearing Support
- Blower Support
- Motor Mounting
- Cutoff
- Housing Sides
- Housing Back
- Blower Pulley
- Motor Pulley
- Belt

And, besides, there are labor, purchasing, warehousing, painting and stocking costs, material spoilage and waste, attendant merchandise losses, inventory costs, plant handling, and the cost of final assembly. If blower is not installed in the furnace before shipment there are additional, expensive packaging costs.

There are many positive advantages—the ultimate one being *exact, known costs*—in buying blowers completely assembled, packaged, ready to put on the line. It may seem a simple matter to buy wheels and then build housings for them. But it isn't so simple—your problems are innumerable, and your costs questionable. Besides, the combination may not be exactly right for efficient air delivery performance.

Lau has an investment of thousands of dollars in engineering and equipment to say nothing of years of testing and research in order to produce standardized blowers with precision-matched wheels and housings for best possible performance. Performance is a known quantity. Costs are known. Mass production facilities of this largest manufacturer of furnace blowers make it possible for Lau to offer you unmatched low prices for complete blower assemblies. If you've been thinking about building your own blowers, get all the facts first. Write.

THE LAU BLOWER COMPANY
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NATIONAL WARM AIR HEATING
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WORLD'S LARGEST MANUFACTURER OF FURNACE BLOWERS

Horizontal unit heaters are available in 12 sizes with capacities from 96 to 1250 EDR steam. Down flow units are offered in 16 sizes from 136 to 2082 EDR steam, and a wide range of blower types provide capacities from 497 to 5495 EDR steam.

Rock Drill Has Many Uses

No. 3639—A new rock drill designated as the J-10 "Utility Jackhammer" has been announced by Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

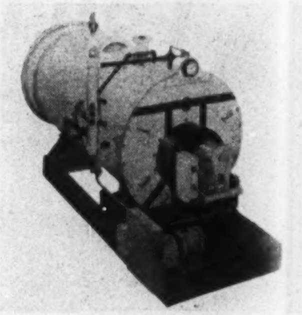
It is said to provide automatic rotation and uses standard "Jackbits." By using adapters, star drills can be used to drill holes 1⅛ in. and under. Also by removing the rotation pawls or using round shanked tools it can be used as a light paving breaker or for chiseling and channelling. An oil reservoir, in the handle, supplies lubrication and is said to be one of the reasons for the low upkeep cost of the tool.

Tube Fittings Designed For Heavy Duty Service

No. 3640**—A new line of commercial tube fittings has been designed for heavy duty service and long life by Flodor Corp., 331 Frankfort Ave., Cleveland, Ohio.

The fittings are said to be unusually heavy and strong and are made of cadmium plated steel. They are made in sizes from ¼ to 1½ in.

Steam Generator Handles All Standard Grades of Oil



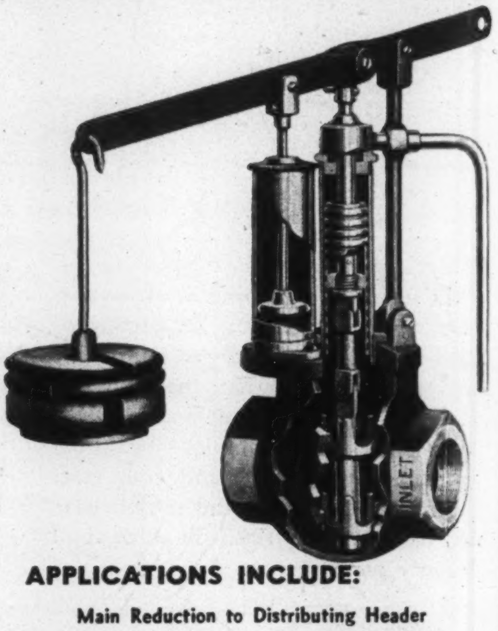
No. 3641**—Fully automatic, packaged steam generators in sizes from 20 to 500 bhp have been developed by Superior Combustion Industries, Inc., Emmaus, Pa.

Units may be obtained to burn any grade of fuel oil including Bunker C, and in addition, they may be furnished to burn natural gas or with combination gas-oil equipment. Generators are designed for pressures from 15 to 200 psi and are built in accordance with the requirements of the ASME, the National Board of Fire Underwriters, and the NEC. When insulated with 2 in. of magnesia or its equivalent, they carry a written guarantee of 80 percent thermal efficiency.

Company Organized to Form Tube Products

No. 3642**—B & M Mfg. Co., 19 N. Harrison St., East Orange, N. J., has recently been formed to manufacture spirally formed tubular products under the trade name of "Spiralock."

KLIPFEL No. 1
PISTON & DASH POT
REDUCING VALVES



...your Best Bet to Cover a **WIDE** Range of Pressures.

Yes, Klipfel No. 1's are truly versatile—just one valve will cover a wide range of pressures—especially desirable where valves are carried in stock for unknown conditions; when pressure at the individual application is unknown or changes from season to season.

Dependable, too, for there is no diaphragm, no stuffing box, no springs to get out of order. The Klipfel No. 1 is practically fool-proof.

Sold through wholesalers everywhere.

Klipfel
AUTOMATIC REGULATING VALVES

APPLICATIONS INCLUDE:

Main Reduction to Distributing Header
Auxiliary Engines
Vulcanizers
Kettles
Ironers
Dryers
Pumps
All services above 5 lbs.

***Write DEPT. C-12 for* BULLETIN NO. 144**

Describes and illustrates Klipfel's complete line of reducing valves.

KLIPFEL MANUFACTURING CO., HAMILTON, OHIO

"Please!"

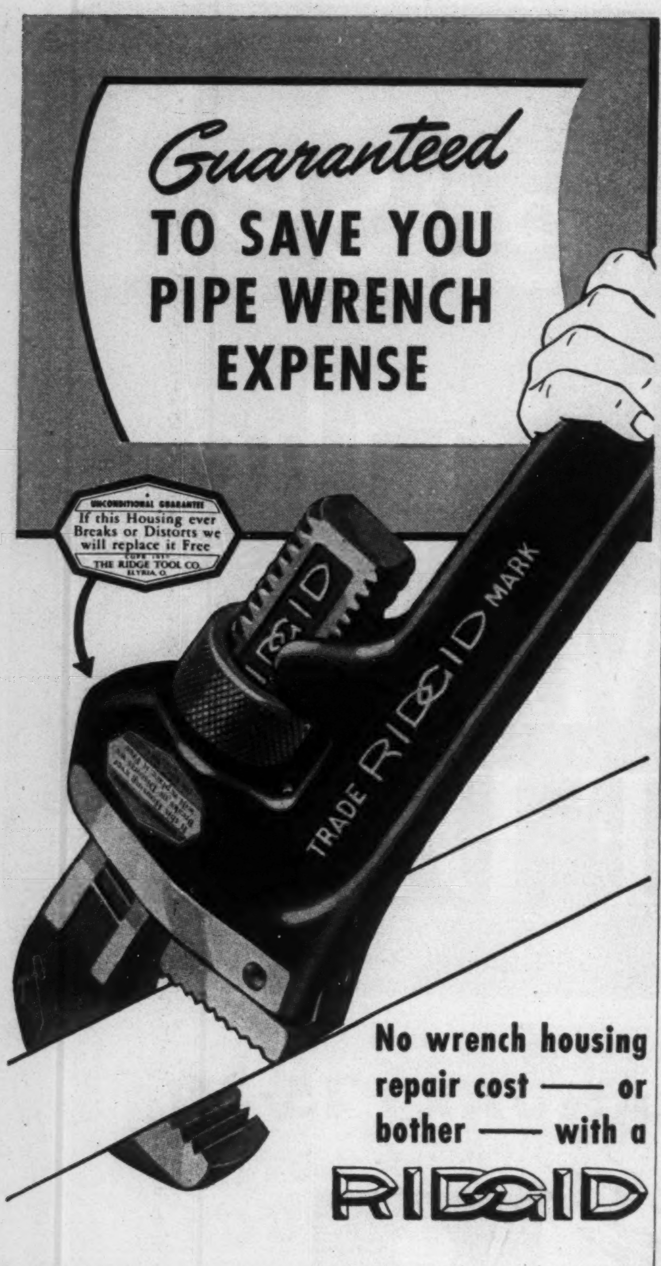
Join the MARCH OF DIMES

JANUARY 15-30

FIGHT INFANTILE PARALYSIS

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

FRANKLIN D. ROOSEVELT, FOUNDER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UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO.
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RIDGID
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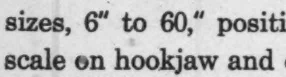
No wrench housing repair cost — or bother — with a
RIDGID

● It's powerful, it's easier to use, it's trouble-free — and that guaranteed housing practically ends upkeep expense. Like millions of users, you enjoy the easy spin of the adjustment nut in all sizes, 6" to 60," positive action jaws, handy pipe scale on hookjaw and comfort-grip I-beam handle.



RIDGID *Strap Wrench protects polished pipe.*

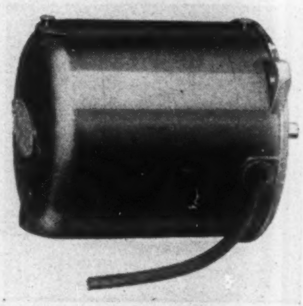
For efficiency and low cost, it pays you to buy the popular RIDGID—see it at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

One product is a new tube with an improved interlocked spiral joint. The increased mechanical strength of its construction is said to make possible the use of lighter wall thicknesses. It can be made of any desired material available in strip form, ranging from carbon steel and galvanized iron to such alloys as stainless steel and monel.

Other tubular products to be manufactured will include spirally formed butted joint, overlapped joint, and open seam tubing made from strip in various materials.

Oil Burner Motor Now in Production



No. 3643—Jack & Heintz Precision Industries, Inc., Cleveland 1, Ohio, has started production on a newly designed electric motor for oil burner application.

The new motor, type C1604-25, is a 1/6 hp split phase unit designed to operate on 115 volts, 60 cycles, at a constant speed of 1725 rpm. A manual reset overload protector is provided. The unit is totally enclosed, provides optional rotation, and has a standard NEMA two-lug mounting flange.

Electrolytic Unit Designed to Prevent Corrosion, Scale Formation

No.3644**—The "Beco Cell" is a self contained metal unit which is designed to remove old scale and to prevent corrosion and scale formation, together with priming and foaming in boilers, tanks, treaters, and wherever steam and hot water are used.

The device is submerged in the water and is said to generate a slight negative current which attacks and neutralizes foreign particles and substances, rendering them incapable of ionic attraction.

Area Meter Measures Flow of Viscous Liquids

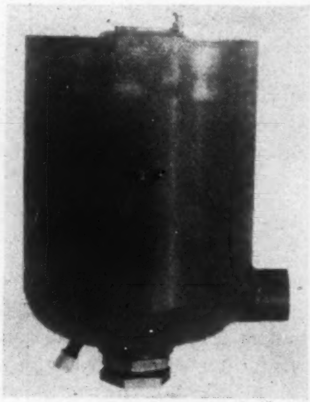
No. 3645—A new electronically-operated area meter developed by Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio, is said to measure accurately the more viscous liquids—black liquor, tar, chemicals, distillates, and refrigerants; as well as the freer flowing liquids—water, oil, gasoline, etc.

This flow measuring instrument consists of a specially designed telemetering transmitter connected to a standard company electronic receiver. The transmitter is installed in the pipe line, much like a valve.

The meter is said to have several advantages over other types of flow meters. Its installation is simplified as the recorder is constructed of packaged electronic components which do not need to be carefully leveled and are not affected by vibration. The recorder may be calibrated to read in terms of volumetric units thereby reducing errors due to density changes, and two transmitters may be connected to the same recorder to measure the ratio, sum, or difference of two flows.

The transmitter has a port area varied by a plug restrained with a calibrating weight or spring. The plug is designed to assume a position proportional to the rate of flow. This results in a substantially constant pressure drop; usually 2 psi if a weight is used for calibration or 10 psi if a spring is used. The plug is directly connected to the soft iron core of the telemeter transmitter and any movement of the plug causes a voltage ratio variation in the telemeter circuit. This variation is transmitted to the receiver, which may be an indicator, recorder and/or controller. The electronic receiver employs an impedance bridge measuring circuit which is sensitive to any unbalance in voltage ratio and therefore reacts to the movement of the plug.

Offers Oil Filter to Protect Tools, Machines



No. 3646**—"Micronic" oil filters, for industrial applications where the efficiency and service life of tools and machines are dependent on keeping foreign material out of oil systems, are offered by Greer Hydraulics, Inc., 454 18th St., Brooklyn 15, N. Y.

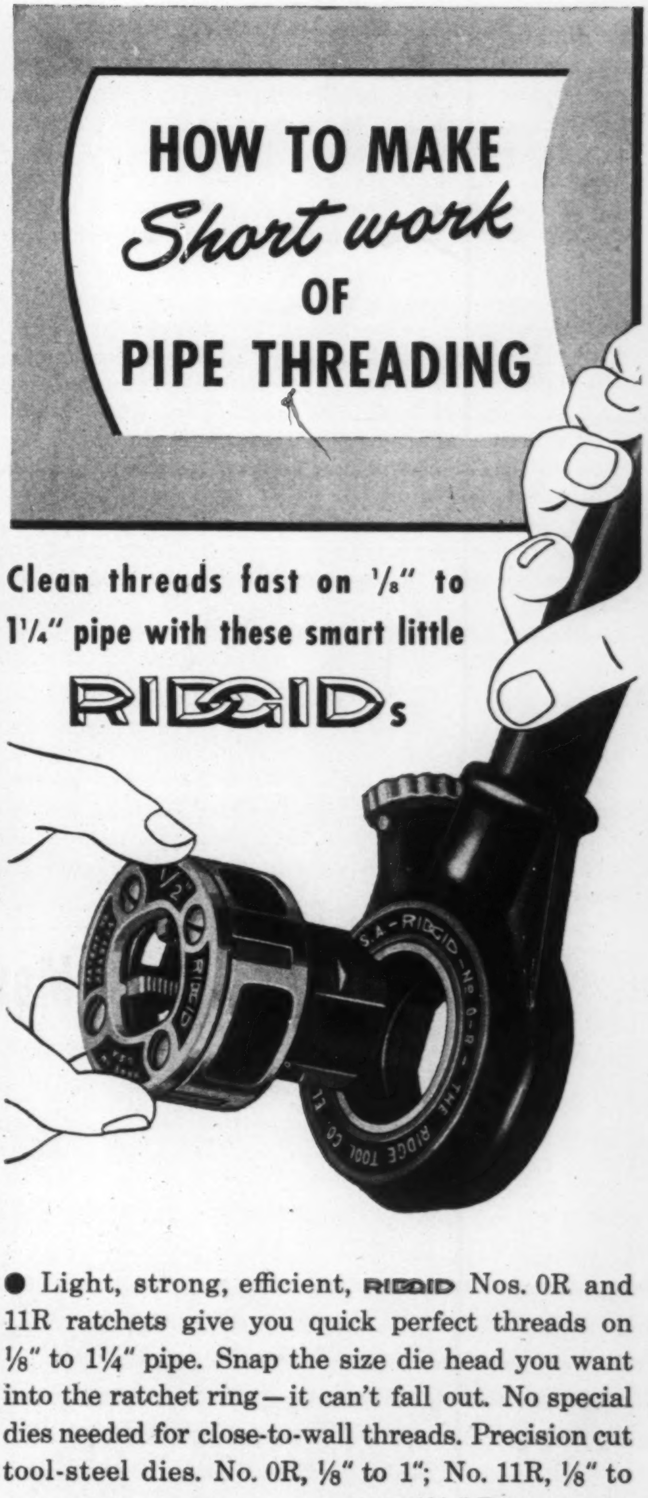
The fluid enters the filter at the intake port and is directed against a shield which is designed to diffuse the flow and prevent impurities from striking the filter element directly. The oil then flows through the filter element (Army-Navy specification AN 6236), then through a series of slots in the center shaft, and out through the discharge port. Sediment collects in the bottom of the shell and is eliminated through a drain port.

The unit shown here is designed for 30 gpm at 250 psi. Other sizes can be supplied depending on pressure and flow requirements.

Equipment Shorts

Allis-Chalmers Mfg. Co., Milwaukee, planned for a postwar employment increase of 50 percent which would bring the company's total employment to about 25,000. At the present time more than 31,000 persons are employed and in several of the plants, located in areas of tight labor markets, additional personnel is required. President Walter Geist reports, "We have been happy to note an increasing spirit of cooperation between employees and management, which is certain to mean a more prosperous future for both the individual worker and the company."

Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has obtained a long term lease on a new factory building in Stratford, Conn. Production of the company's Ashcroft gage line will be moved from the Bridgeport plant to the new factory, thus opening the way for the expansion of the Consolidated safety valve and American industrial instrument lines at the present Bridgeport location.

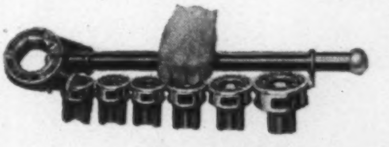


HOW TO MAKE *Short work* OF PIPE THREADING

Clean threads fast on ⅛″ to 1¼″ pipe with these smart little RIDGIDs

½
RIDGID
S.A.-RIDGID-No. 0-R-THE RIDGE TOOL CO.

● Light, strong, efficient, RIDGID Nos. 0R and 11R ratchets give you quick perfect threads on ⅛″ to 1¼″ pipe. Snap the size die head you want into the ratchet ring—it can't fall out. No special dies needed for close-to-wall threads. Precision cut tool-steel dies. No. 0R, ⅛″ to 1″; No. 11R, ⅛″ to 1¼.″ Buy at your Supply House.



Free handy carrier for any group of sizes.

RIDGID

WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

Equipment Shorts (Cont.)

Because of stepped up production, Pittsburgh Lectrodryer Corp., Pittsburgh, has announced immediate delivery on its laboratory "Lectrodryer." The unit, of aluminum construction, is portable, is used for drying gases or air up to about 100 cfh, and is designed to adsorb about 550 grains of moisture before reactivation is necessary.

Allegheny Ludlum Steel Corp., Pittsburgh, has accepted the counter proposal made by the War Assets Administration for the sale of the government constructed steel plant in Dunkirk, N. Y. The plant, which was operated by Allegheny Ludlum during the war for the production of bullet core steel, will now be used for the production of stainless steel wire.

The company has also purchased a 40 in. slab blooming mill from the Morgan Engineering Co., Alliance, Ohio. The electrically powered mill will be delivered in late 1948 and will replace the blooming mill at the company's Brackenridge, Pa., plant.

Construction projects that will increase the manufacturing facilities of six different divisions of Borg-Warner Corp. are under way or soon will start. The current construction work is part of an overall expansion program begun in 1940. Since then about $35 million has been spent or committed for improved or enlarged production facilities.

American Rock Wool Co., Wabash, Ind., will construct a plant in Birmingham, Ala., for the production of loose rock wool, granulated rock wool, and wool batts. The plant site was purchased from the War Assets Administration and was formerly the Southern Detinning Corp. plant. Work to be done includes removal of existing equipment, construction of new buildings, and changes in existing structures.

H. B. Smith Co., Westfield, Mass., manufacturer of cast iron boilers, recently paid honor to its old time employees at a testimonial dinner. Particular honor was paid to 92 employees having service records of 25 years or more. Of these men, 19 have been with the company over 40 years.

Installation of a new Yoder electric resistance weld tube mill has been completed at the plant of Wheatland Tube Co., Philadelphia. The mill is capable of producing from ½ x 0.030 in. to 3 x 0.135 in. wall tubing or from ¼ to 1 in. standard weight pipe. It forms, welds, removes external flash, cools, sizes, straightens, and cuts the finished tubing into lengths from 4 to 20 ft.

Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., has announced the availability of an improved carrying case for transporting a welding or cutting outfit to the job. Torch, tips, regulators, hose, gloves, goggles, wrenches, and miscellaneous equipment can be carried in the 10½ lb case which measures 22 x 8 x 9 in.

SMALL SERIES VERTICAL
SERIES 200 ATMOSPHERIC

Marley Medium Capacity Towers

For Every Location

Atop a building . . . on the ground . . . obstructed from breeze . . . in open, unobstructed site . . . every location for a cooling tower constitutes an individual problem. Complete Marley line includes a unit that accurately fills any requirement.

SMALL SERIES VERTICAL INDUCED DRAFT TOWERS

For Controlled Performance or to Enhance Architectural Design

- Accurate predetermined temperatures
- Wood or steel casing to conform to building codes.
- Spray or wood filled as operating conditions require.
- Marley triple-effect drift eliminators.

SERIES 200 ATMOSPHERIC SPRAY TOWERS

For Open Location

- Unit built for lowest installation cost.
- Low pressure distribution for economical operation.
- Prefabricated for ease of erection.
- Structurally strong for long, trouble-free service life.
- May be readily expanded for greater capacity.

Marley Way . . . The Perfect Spray

Marley Patented Spray Nozzles for cooling towers, processing and air washing provide maximum distribution at lowest pressure. Absolute minimum of maintenance is necessary.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

EXECUTIVE CHANGES

W. C. Newberg has been named president of the Airtemp division of Chrysler Corp., Dayton, Ohio, to succeed D. W. Russell who is retiring. Mr. Newberg joined Chrysler in 1933 as a student engineer. He has served in various engineering departments, and during the war was chief engineer of the company's huge Dodge-Chicago plant where engines for B-29 bombers were produced.

The Fluor Corp. Ltd., Los Angeles, has announced its new managerial organization necessitated by the recent death of the company's president and chairman of the board, Peter E. Fluor. S. E. Meserve, vice president and general counsel, has been elected president. He has supervised the company's legal affairs since 1926 and was made a director of the corporation in 1937. W. E. Dunn, vice president and general manager, will now serve as executive vice president, D. W. Darnell, vice president and chief engineer, has been promoted to vice president and general manager, and J. P. Wiseman and T. H. Seavey, director of sales and manager of purchases respectively, were both named vice presidents. F. E. Fisher continues as secretary-treasurer. R. L. Merrick has been elevated to chief engineer.

P. S. Park has been named manager of the engineering service department of A. M. Byers Co., Pittsburgh, manufacturer of wrought iron. Besides handling engineering problems dealing with the use of wrought iron pipe and plate in various fields, he has been instrumental in the development of radiant heating and snow melting systems.

The Burkay Co., Toledo, Ohio, has announced the appointment of A. F. H. Scott as vice president in charge of sales of its heating products division. In addition to having an exceptionally broad background in the heating industry, he was special assistant to the deputy administrator, Federal Housing Administration, from 1934 to 1937 and was principal consultant to the Office of Price Administration during the early formation days prior to Pearl Harbor.

The recent appointment of N. B. Schreiber as board chairman and general manager of General Engineering & Mfg. Co., St. Louis, has been announced by directors of the company. A major development in sales plans has already been made by Mr. Schreiber in the appointment of five regional sales managers. He is not related to J. H. Schreiber, president of the company, who will continue to devote his full attention to the engineering improvement and development of products.

V. P. Black, who joined the Airtemp division, Chrysler Corp., Dayton, Ohio, in February 1935, has been named advertising manager of the division. After serving in various capacities, he took charge of advertising in 1939

QUICK
EASY 1" TO 2"
Pipe Threading

RIDGID No. 65R

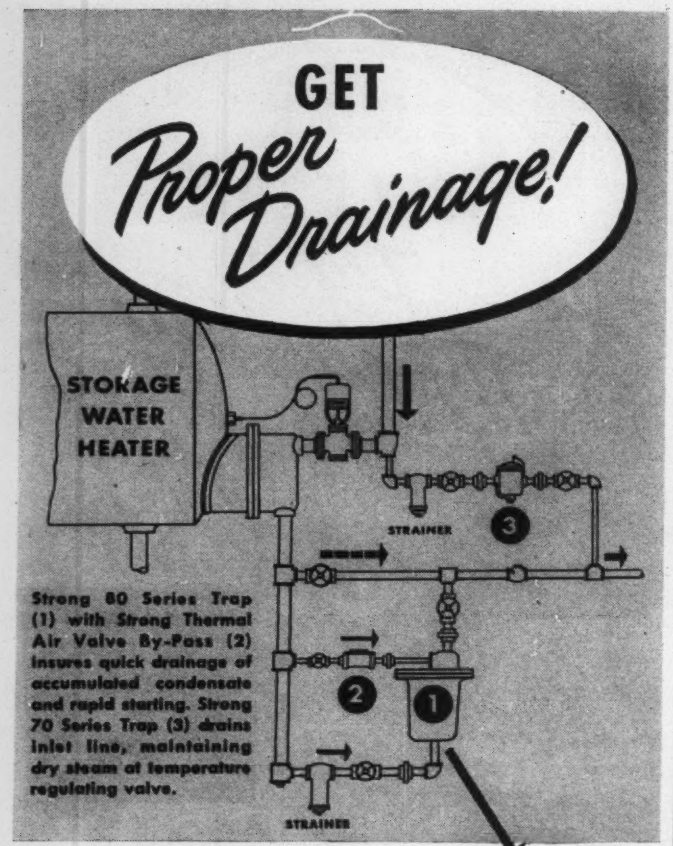
10 second adjustment to size instant-setting workholder

● You can't beat the self-contained semi-automatic 65R for speedy get-ready or smooth perfect threads. Its one set of high-speed steel dies adjust to pipe size in 10 seconds. Mistake-proof workholder sets instantly—one screw to tighten, no bushings to bother with. It cuts clean accurate 1" to 2" threads fast, with least work. Durable all-steel-and-malleable. Save time and effort—buy 65R at your Supply House.

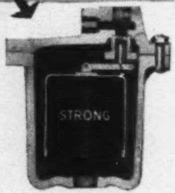
Every 65R must cut a perfect thread before it leaves the factory.

RIDGID

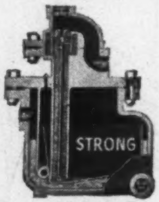
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO



Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.



Strong 80 Series Trap for medium or high pressures.



Strong 30 Series Trap for high, medium or low pressures.

PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

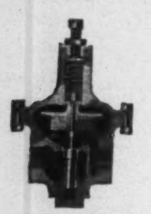
Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 67 today for complete details of *all* Strong traps.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

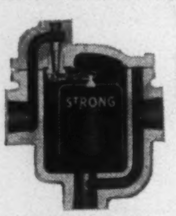
REG. TRADE MARK

ANUM-METL
Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



Reducing Valve



70 Series Trap

Strainer

STRONG

Executive Changes (Cont.)

and during the war he was manager of Airtemp Construction Corp., a wholly owned subsidiary.

McQuay, Inc., Minneapolis, manufacturer of refrigeration and air conditioning equipment, has named C. T. Bappler as its sales manager for the eastern division. He is a former secretary of the Fin Coil Manufacturers Association and entered the refrigeration industry in 1924.

The appointment of R. W. Qualley as chief product design engineer has been announced by Meyer Furnace Co., Peoria, Ill. In his new capacity, Mr. Qualley will have charge of the development of new automatic heating equipment for the Meyer and Weir lines. Another phase of his work will be the application of latest developments to present products. He is a graduate of the University of Minnesota and is a registered professional mechanical engineer in the state of Ohio.

Election of E. W. Meyers, Jr. as president of Trion, Inc., McKees Rocks, Pa., has been announced by P. W. Aitkenhead, who resigned as president to become chairman of the board. The company, formerly known as the Pittsburgh Stove and Range Co., was reorganized in February to manufacture electrostatic air filters.

Vapor Car Heating Co., Inc., Chicago, has appointed R. B. Neuman as director of publicity and advertising. Mr. Neuman has been active in the Milwaukee Ad Club and at the present time is editor of Torch, the club's publication. He is also president of the Editors Association of Wisconsin.

The appointment of R. L. Towne as sales promotion manager for Rheem Mfg. Co., New York City, has been announced by H. C. L. Johnson, advertising manager. Mr. Towne, who will make his headquarters in New York, has had extensive experience in the heating business.

L. H. Benson has joined Tuthill Pump Co., Chicago, as vice president in charge of manufacturing. He comes to the company with a background of mass production experience over the past 40 years with a number of wellknown organizations.

Baker Ice Machine Co., Inc., has appointed W. W. Woodroof as manager of distributor sales in the refrigeration and air conditioning fields. He will have his headquarters at the company's new plant in South Windham, Me.

G. E. Garthorne, A. L. Buonaccorsi, and J. E. Murray, previously of G. M. Richards & Associates, have announced their association in the practice of electrical and mechanical engineering. The new firm is located at 1095 Market St., San Francisco 3, Calif.

NEW BOOKS & REPORTS

Provides Overfire Air Jet Data For Commercial, Industrial Plants

To provide commercial and industrial plants with an improved guide on how to design, construct, and install overfire jets for smoke prevention, Bituminous Coal Research, Inc., has published a revised and enlarged issue of Application of Overfire Jets to Prevent Smoke From Stationary Plants.

The publication, written by R. B. Engdahl, assistant supervisor, Battelle Memorial Institute, and W. S. Major, BCR development engineer, covers the cause of smoke and how the jet functions to keep smoke formation to a minimum. All example studies are now coupled with drawings showing furnace views before and after overfire jet application. Drawings have also been added to show construction details of popular sizes of steam-air jets built from standard pipe and fittings.

A feature of this new publication is the inclusion of "work sheets" for use in designing either steam or blower actuated jets for any type of boiler furnace. These work sheets carry systematic reference to the simplified graphs, tables, and formulas that are used in determining air tube size, tube spacing, number of tubes, nozzle size, etc.

Copies of this booklet, Technical Report No. 7, are available from the technical information service of BCR, 912 Oliver Bldg., Pittsburgh 22, Pa.

Gives Minimum Requirements for Oil Burner, Storage Tank Installations

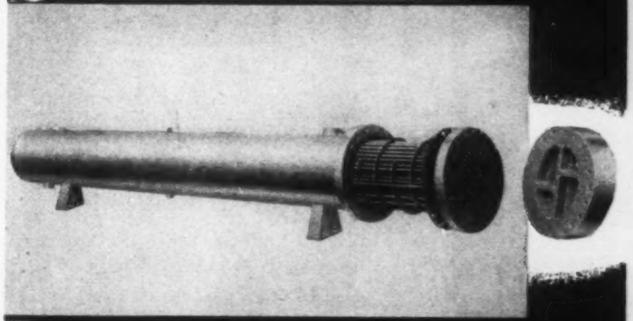
For the purpose of insuring "the best" in oil burner and accessory installations the Oil-Heat Institute of America has published a booklet on Oil Burner and Oil Storage Tank Installation Standards. The standards apply to all types of oil burning equipment and in more or less general terms prescribe reasonable provisions which are based on minimum requirements for good efficiency and the protection of property and equipment.

After defining the terms used in the booklet and after mentioning the necessity for obtaining permits, it is recommended that plans or sketches of the proposed installation or alteration be prepared and submitted to the proper local government official or to the inspection department of the state insurance rating department. A table of thicknesses for tanks from 7 to 30,000 gal capacity is given and it is stated that underground and inside tanks are to be of wrought iron or steel. Standards for tank construction, and the installation of inside, underground, and outside tanks, are given. Information is included on gravity feed tanks, pressure feed tanks, vents, filling, gaging, piping, valves, and pumps. Other topics covered include combustion chambers, burner installation, controls, preheating oil, and tests.

It is to be noted that these standards do not constitute hardship rules and that much is left to the judgment of the installer. For example, "underground tanks shall be set on firm foundation......where necessary to prevent floating they shall be securely anchored or weighted. Inside storage and auxiliary tanks shall be securely sup-

PATTERSON-KELLEY
Heat Exchangers
AND
Process Equipment

Heat-Transfer
SPECIALISTS



Specializing
IN REFRIGERANT COOLERS

The very essence of "air conditioning" is the controlled transfer of heat.

It was entirely logical, therefore, that Patterson-Kelley engineers, who have specialized for years in heat-transfer equipment, should turn their attention years ago to refrigerant coolers, condensers and other heat-transfer equipment needed in air conditioning and refrigeration systems.

Today, Patterson-Kelley Equipment, coolers for example, is considered by many to be the standard for such installations.

EST 1880
THE PATTERSON-KELLEY Company, Inc.
107 WARREN STREET, EAST STROUDSBURG, PA.
NEW YORK 17—101 Park Ave.
PHILADELPHIA 3—1700 Walnut St.
CHICAGO 4—Railway Exch. Bldg.
BOSTON 16—96-A Huntington Ave.
Representatives in Principal Cities

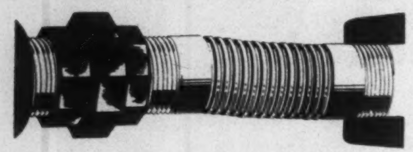
Calling all JOBBERS!

WHEN TAPPINGS ARE COCKEYED USE
Paracoil
We Stock
FLEXIBLE NIPPLES
THEY BEND!
MAKE TOUGH JOBS EASY!
SAVE TIME AND LABOR!
REDUCE COST OF INSTALLATION!
INCREASE HEATER CAPACITY!
MADE IN 4 SIZES: ¾" x 3"...1" x 4" 1¼" x 4½"...1½" x 5"
THE OLD WAY!
3 pipe nipples— 2 Ells—1 union To Every Section!
THE PARACOIL WAY!
1 nipple—No Ells— 1 union and a FLEXIBLE NIPPLE! That's All!
FLEXIBLE NIPPLE
Manufactured by
DAVIS ENGINEERING CORPORATION
ELIZABETH NEW JERSEY

10" x 14"
EYE CATCHING
COUNTER CARD

The Fast Selling Paracoil

FLEXIBLE NIPPLES



THEY BEND!

are back again!

THE "PARACOIL" FLEXIBLE NIPPLES have always been one of the fastest moving items on the jobber's shelves. Every steamfitter and plumber that ever used them knows how they lick the problem of the "cockeyed" tapping, and the out-of-line pipe run. Now available once more, shipments are breaking every previous record!

Helping to keep these fittings moving from jobber to contractor are some of the most striking sales aids ever used for a plumbing or steamfitting specialty. Large 4-color counter cards and explanatory stuffers that stop and sell at a glance, are available FREE to every jobber that stocks these items. They are proven profit makers!

Write today for details—your customers will thank you for handling the line.

Paracoil
FLEXIBLE NIPPLES
THEY BEND!

Flyers for your counter and direct mail are part of our sales aid.

DAVIS
ENGINEERING CORPORATION
1064 East Grand Street, Elizabeth 4, N. J.

ported by substantial incombustible supports to prevent settling, sliding, or lifting." Outside underground tanks and piping are to be tested to not less than 1½ times the maximum working pressure, and burners are to be adjusted to give a CO_2 content in the flue gas of not less than 8 percent.

Copies of this 16 page booklet may be obtained from OHI headquarters, 6 E. 39th St., New York 16, N. Y.

Psychrometric Charts Cover Low, Normal, High Temperatures

The American Society of Refrigerating Engineers has issued ASRE Brochure on Psychrometry. This booklet, preprinted from the 1948 sixth edition and basic volume of the Refrigerating Data Book, includes three psychrometric charts covering the low, normal, and high temperature ranges. The new charts are arranged for convenient use and they are said to give precise results through the use of enthalpy deviation lines drawn directly on the chart. In addition, adjustments for rejected or added moisture may be readily made.

Tables are included which make it possible to adapt the charts for solving problems when the barometer or altitude deviates from standard. The psychrometric tables on the thermodynamic properties of air and steam, which are included, were prepared by Prof. C. O. Mackey, Cornell University; the brochure was written by E. P. Palmatier, Carrier Corp., and D. D. Wile when he was associated with that company.

Copies may be obtained from ASRE headquarters, 40 W. 40th St., New York City, for $1.00 each.

ASTM Standards on Coal and Coke Include Specifications and Tests

In addition to some 33 specifications, methods of tests, and definitions developed by the American Society for Testing Materials through the work of its committee D-5, the 1947 Standards on Coal and Coke includes eight proposed test methods published for information and comment.

Also included in the standards are 14 methods of testing coal covering such subjects as sampling according to ash content, laboratory sampling and analysis, sampling and fineness of powdered coal, test for size of anthracite, sieve analysis of crushed bituminous coal, cubic foot weight of crushed bituminous coal, index of dustiness, and the free swelling index of coal.

There are three specifications covering the classification of coals by rank, by grade, and for gas and coking coals. Also included are methods of sampling and testing coke, together with definitions for such terms as the gross and net calorific value of fuels, as well as definitions for commercial varieties of bituminous and subbituminous coals.

Copies of this 162 page, paper covered booklet can be obtained from ASTM headquarters, 1916 Race St., Philadelphia 3, Pa., for $2.00 each.

Other Books and Reports Received

Continuous Air Conditioning With the Heat Pump, by E. B. Penrod, head, department of mechanical engineering, University of Kentucky. Published in the Vol. 35, No. 4 issue of American Scientist, c/o Osborn Zoological Laboratory, Yale University, 165 Prospect St., New

Other Books and Reports Received (Cont.)

Haven, Conn., pp. 502-524. Discusses basic fundamentals, coefficient of performance, theory and performance of earth to air, water to air, and air to air units, and also summarizes test and design data on some commercial and domestic installations. Data and a chart on comparative heating costs are included.

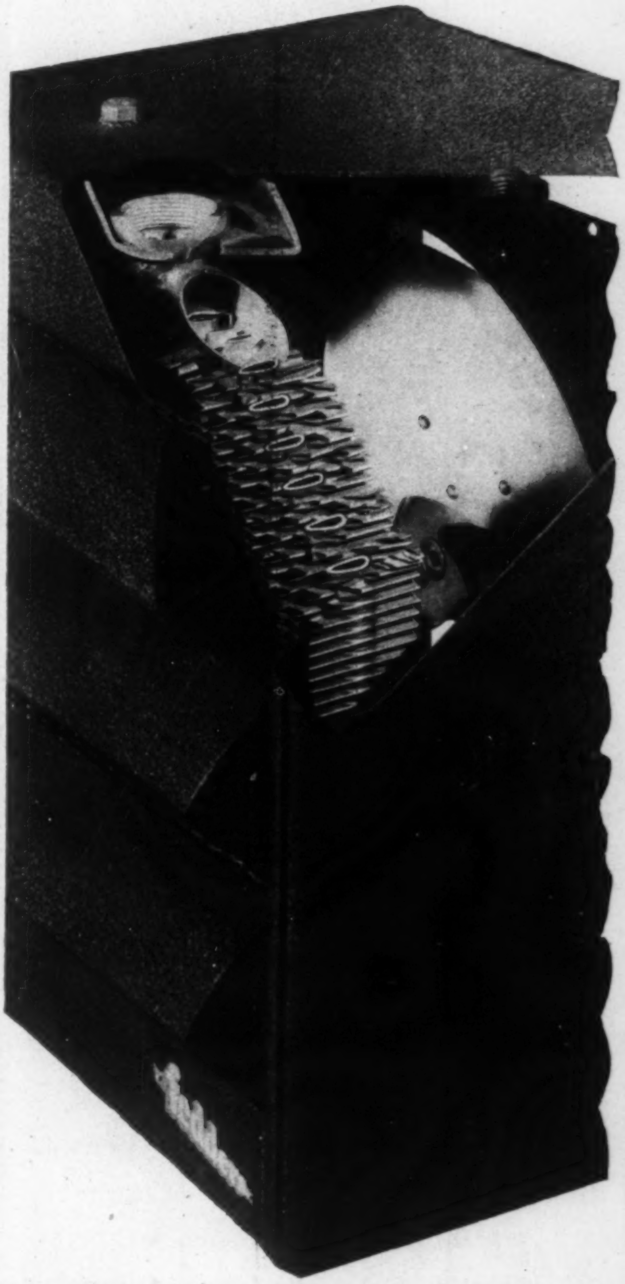
Trends in Solid Fuel Research, by H. J. Rose, vice president and director of research, Bituminous Coal Research, Inc. An address presented at the fuels general luncheon, 1947 semi-annual meeting of the American Society of Mechanical Engineers and reprinted by the society (headquarters, 29 W. 39th St., New York City). As a basis for concluding that coal will be used in enormous quantities and in synthetic chemical industries our tremendous reserves are cited and research and developments in coal preparation and handling, gasification and carbonization, and in the coal burning gas turbine are discussed.

Building Materials and Structures, Supplement No. 2 to Report BMS17—Sound Insulation of Wall and Floor Constructions. Published by the United States Department of Commerce, National Bureau of Standards and available from the U. S. government printing office, Washington 25, D. C. at 25 cents per copy. This supplement reports the results of sound transmission measurements made on a number of additional types of constructions since the issuance of the original report in March 1939 and the first supplement issued in December 1940.

Modern Views on Ventilation, Warming, and Cooling, by G. P. Crowden and T. C. Angus. Published in the Vol. 159 issue of The Practitioner, 5 Bentinck St., London, W. 1., England. Discusses the broad general principles governing British practices in heating and ventilating. While of no particular value to the American designer, it may be of interest from the standpoint of recommended comfort conditions such as 60 to 68 F dry bulb.

Overfire Jets and Controls for Locomotive Smoke Abatement, by E. D. Benton. Identified as technical report No. 8 by Bituminous Coal Research Inc., 912 Oliver Bldg., Pittsburgh 22, Pa., 25 cents per copy. Contains detailed recommendations for the design, installation, and use of overfire air jets in locomotives. The report is based on results of studies at the fuel research laboratory, Battelle Memorial Institute, and experience gained from applications to many classes of locomotives under a wide variety of operating conditions.

Index to 1946 ASTM Standards, published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. This 242 page index lists 1400 standard specifications and tests. Copies are available at no charge.



FEDDERS
UNIT HEATERS
are worth looking into

Satisfaction depends on what is behind a name plate, in design . . . in construction . . . in materials . . . in reputation.

This cutaway view of Fedders Series 15 Unit Heaters shows the streamlined copper tubes, deep flanges extruded into headers, individual copper fins with large area bond to tubes.

Also, Fedders full floating element mountings relieve expansion stresses between core and cabinet. Low final temperatures and quiet broad blade fans assure correct comfort distribution.

Write for bulletins covering horizontal and downblow models.

FEDDERS - QUIGAN
CORPORATION
BUFFALO 7, NEW YORK
Representatives in Principal Cities

MAGNA Therm
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MAGNA Fin
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Immediate Delivery

MAGNA-Therm UNIT HEATERS

Order NOW for immediate delivery. Don't risk Fall shortages. Write for Catalog MTH

MAGNA-Fin CONVECTORS AND RADIATORS

Write for Catalogs MFC and MFR

THE Rittling CORP.

Manufacturers of Fin Tube Surfaces
Inquiries Invited

1292-1298 Niagara St., Buffalo 13, N. Y.

MEETINGS & CONVENTIONS

Agricultural Engineers to Discuss Barn Hay Drying

The winter meeting of the American Society of Agricultural Engineers, P.O. Box 229, St. Joseph, Mich., will be held at the Stevens Hotel in Chicago, December 15 to 17. The extensive program will include three papers on the uses of radiation in agriculture, to be presented Monday evening, December 15. On Tuesday morning, December 16, the farm structures and rural electric joint program will deal exclusively with grain and corn drying. Continuing the program that afternoon, a portion of the session will be devoted to a symposium of brief reports on the 1947 results of barn hay drying research. A discussion of these reports will be held at a round table session scheduled for that evening. In the afternoon session of the farm structures program, December 17, W. C. Krueger, Rutgers University, will present a report on the results of comparative studies of insulated and noninsulated dairy barns.

Technical Program to Feature NACE Conference and Exhibition

The fourth annual conference and exhibition of the National Association of Corrosion Engineers, 67 Wall St., New York 5, N. Y., will be held April 5 to 8, at the Jefferson hotel, St. Louis. The technical program will include symposia on cathodic protection, the chemical gas, and oil industries, protective coatings for metals, and salt water corrosion. The exhibition will feature displays showing equipment, materials, and methods for combating corrosion.

Sponsors Midwest Power Conference

The 10th annual Midwest Power Conference, to be held at the Sheraton hotel, Chicago, April 7 to 9, will again be sponsored by the Illinois Institute of Technology, 3300 S. Federal St., Chicago, in cooperation with nine midwestern universities and eight engineering societies. S. E. Winston, director of the evening division at Illinois Tech., again will be director of the conference.

To Hold West Coast Refrigeration Conference

The 1948 Western Refrigeration Educational Exhibit and Conference will be held at the Palace hotel, San Francisco, April 30, May 1 and 2. The show will be sponsored by the Oakland and Golden Gate chapters of the Refrigeration Service Engineers Society. Reservations should be made directly with the Palace hotel.

Foundrymen to Meet in Philadelphia

W. W. Maloney, secretary-treasurer of the American Foundrymen's Association, 222 W. Adams St., Chicago, has announced that the 1948 convention and foundry show will be held in Philadelphia, May 3 to 7. Most of the technical sessions of this 52nd annual meeting and the exhibit of foundry supplies, equipment, and products will be held at the Philadelphia Convention Hall. Evening sessions and special events will be held at downtown hotels. According to the announcement, ample hotel accommodations have been assured. Attendance is expected to break all previous records and many new and improved products will be on display for a worldwide castings audience.

ASTM Announces 1948 Meetings

The American Society for Testing Materials, 1916 Race St., Philadelphia, has announced that the 1948 annual meeting will be held in Detroit during the week of June 21-25, and in conjunction with this will be the Eighth Exhibit of Testing Apparatus and Related Equipment. Several Detroit hotels will cooperate, but headquarters will be at the Book-Cadillac. The 1948 committee week and spring meeting will be held in Washington, D. C., during the week of March 1-5.

To Hold Catholic Building Convention and Exposition

The National Catholic Building Convention and Exposition will be held June 30 and July 1-3, 1948 at the Stevens hotel in Chicago. The meeting and show, the first of its kind ever held, is being organized because of the great backlog of church construction. Parishes and institutions with building or remodeling problems will obtain advice from experts who will conduct panel sessions on the many phases of parochial building construction. Various types of materials, equipment, and allied requirements of churches, hospitals, schools, and convents will be displayed at the exposition.

The announcement was made by convention president, the Very Rev. Henry A. Lucks, president of St. Joseph's of Indiana, Collegeville, Ind., after he and J. V. Malone, vice president of the convention organization, conferred with Samuel Cardinal Stritch of Chicago. The meeting and exposition, which has the approval and support of many church leaders, will be held by the National Catholic Building Convention and Exposition, Inc., 185 N. Wabash Ave., Chicago 1, Ill.

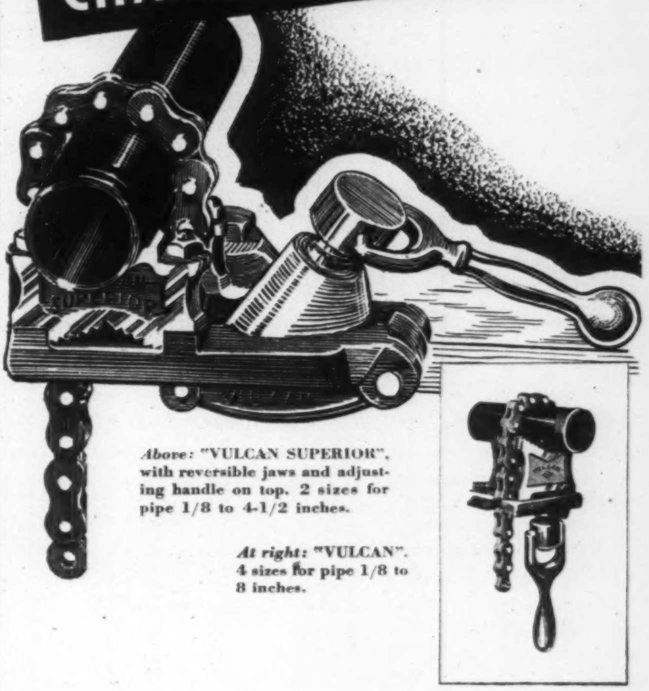
ACS Sets Dates for Chemical Exposition

The dates for the 5th National Chemical Exposition by the Chicago section of the American Chemical Society have been set for October 12 through 16 at the Chicago Coliseum, according to Dr. L. E. Clifcorn, chairman of the ACS exposition committee. M. W. Hinson will again manage the details of this 1948 show. Headquarters of the Chicago section is at 1513 S. Wabash Ave., Chicago 5.

1949 Heating, Ventilating, and Air Conditioning Exposition Scheduled

The 9th International Heating, Ventilating, and Air Conditioning Exposition will be held January 24 to 28, 1949, at the International Amphitheatre, Chicago. Diagrams of exhibit spaces are now being prepared and will be mailed next month to previous exhibitors. As in the past, the show will be under the auspices of the American Society of Heating and Ventilating Engineers and will be held in conjunction with the society's annual meeting.

WILLIAMS
SUPERIOR DROP-FORGED TOOLS
"VULCAN SUPERIOR"
CHAIN PIPE VISES



Above: "VULCAN SUPERIOR", with reversible jaws and adjusting handle on top. 2 sizes for pipe 1/8 to 4-1/2 inches.

At right: "VULCAN". 4 sizes for pipe 1/8 to 8 inches.

- Williams "Vulcan Superior" is an improved vise featuring "over-head" adjustment handle ... making it easier and faster to use. Jaws are reversible providing double the service of conventional vises. It has larger capacity too. Each vise takes pipe 1/2″ larger than other chain pipe vises of similar size. Like all Williams tools it is fully guaranteed. Sold by Industrial, Plumbing & Oil Field Distributors everywhere.

J. H. WILLIAMS & CO., BUFFALO 7, N. Y.

Previously Announced Meetings and Conventions

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—43rd annual meeting, December 8 to 10, Hotel Traymore, Atlantic City.

Fifth All-Industry Refrigeration and Air Conditioning Exposition, January 26 to 29, Cleveland—sponsored by the Refrigeration Equipment Manufacturers Association (see show section in this issue for details).

Eighth International Heating, Ventilating, and Air Conditioning Exposition, February 2 to 6, Grand Central Palace, New York City—under the auspices of the American Society of Heating and Ventilating Engineers (for additional details see ASHVE Journal Section in this issue).

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City—54th annual meeting, February 2 to 5, Hotel Commodore, New York City (see ASHVE Journal Section in this issue for details).

Oil-Heat Institute of America, 6 E. 39th St., New York 16, N. Y.—silver anniversary convention and exposition, April 5 to 8, Chicago Coliseum.

Heating, Piping, and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York City—59th annual convention, June 1 to 5, Hotel William Penn, Pittsburgh.

Sixth All-Industry Refrigeration and Air Conditioning Exposition, the week of November 17, 1949, Cleveland—sponsored by the Refrigeration Equipment Manufacturers Association.

Reports on Continued Studies Of Vapor Transmission

Conventional frame walls constructed with an interior finish having a vapor permeability rate equal to or less than 1.25 gr per sq ft per hr per in. mercury vapor pressure difference may be considered safe in regard to moisture condensation in residential structures. The degree of vapor resistance of the exterior finish is not as critical as the vapor resistance of the interior finish. To minimize effectively the formation of frost in residential attics, ventilation of one air change per hour should be maintained, provided the attic door is made to fit tightly by means of a gasket and the ceiling below is substantially vapor resistant. In calculating the heat loss through a ceiling below an attic and where the attic is ventilated in an amount sufficient to safeguard against condensation, the heat loss due to such ventilation may be neglected without serious error.

These are some of the conclusions reported in a bulletin entitled Moisture and Temperature Control in Buildings Utilizing Structural Insulating Board, by F. B. Rowley, professor of mechanical engineering, M. H. LaJoy, associate professor of mechanical engineering, and E. T. Erickson, research fellow, University of Minnesota. The report covers tests, in a full scale bungalow, which were a continuation of previous studies on vapor transmission of structural insulating boards, sponsored by the university and the Insulation Board Institute.

Copies of this 38 page, paperbound bulletin (No. 26) may be obtained from the Engineering Experiment Station, University of Minnesota, Minneapolis 14, Minn., for 50 cents each.

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 179. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Adjustable Air Diffuser

No. 6692—A new catalog and engineering data book (bulletin K-20) on "Kno-Draft" adjustable ceiling air diffusers has been issued by W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y. Said to contain all the information and data necessary for the proper selection of air diffusers, the manual is offered to architects, engineers, and contractors. Beside data on diffuser types and accessories, much information of a general nature on the subject of air diffusion is included. Copies of the handbook may be obtained from the manufacturer by request on company letterhead.

Air Conditioning and Refrigeration Plant Expansion

No. 6693—Carrier Corp., 302 S. Geddes St., Syracuse 1, N. Y., has published a 16 page booklet describing its $12 million expansion program which is highlighted by the acquisition of a new plant giving the company an additional 660,000 sq ft of manufacturing facilities. A few air conditioning and refrigeration installations are illustrated.

Air Conditioning Systems

No. 6694—Bulletin No. 505-C, issued by the Frick Co., Waynesboro, Pa., has been prepared to explain the fundamental differences in the various types of air conditioning systems recommended by the company. Unit systems, the multiple unit system, the controlled air volume system, the automatic bypass system, the direct system, and cooling with chilled water are described and illustrated. Some of the company's equipment is also illustrated.

Air Drill Hose

No. 6695—Hewitt Rubber Div., Hewitt-Robins Inc., 240 Kensington Ave., Buffalo 5, N. Y., has released a new descriptive folder on its "Monarch" and "Ajax" brands of air drill hose designed for heavy duty service in mines and quarries where resistance to hot oils and abrasion is especially important.

Air Velocity Meter

No. 6696—Hastings Instrument Co., Inc., P.O. Box 1275, Hampton, Va., has issued bulletin No. 1047 covering its new air meter designed to measure air velocities from 5 to 6000 fpm. The hot thermopile principle used in the design of the meter is briefly described and accessories are illustrated.

Analysis of Gases or Vapors

No. 6697—A new illustrated technical bulletin (No. 1143), which describes the new "Micro-Gas" analyzer for the determination and analyzation of gases or vapors

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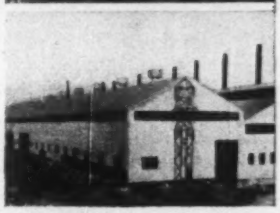
PROVES

Galvanized (ZINC-COATED) Sheets

Stay Stronger Longer



34 YEARS . . . Erected in 1913, and covered with heavy gauge galvanized sheets, this Tennessee concentrating plant of the A/Z Company, pictured at left, is still in excellent condition after more than three decades of service. Painted with Gray Metallic Zinc Paint in 1932.

50 YEARS . . . The galvanized metal roof on this old Missouri farm building has outlasted the building itself, and is still in good condition after half a century of service. Industry and the farm have long depended on galvanizing to protect iron and steel against costly rust. Builders know that as long as iron or steel is zinc covered, it *cannot rust.*

In building for the future, look to the past for proof of a building material's strength . . . durability . . . service. With *galvanized* (zinc-coated) roofing and siding you get the strength of steel . . . the rust protection of Zinc. So for low-cost, long-time service choose the building material that's proved by TIME itself . . . galvanized sheets. Send coupon for information about Zinc and how it helps keep buildings and equipment *stronger longer.*

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This "Seal of Quality" is your guide to economy in buying galvanized sheets. Sheets bearing it carry at least 2 oz. Zinc per sq. ft.

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☐ Repair Manual on Galvanized Roofing and Siding
☐ Facts about Galvanized Sheets
☐ Use of Metallic Zinc Paint to Protect Metal Surfaces

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Town________________State__________

within their toxic range, has been issued by Davis Emergency Equipment Co. Inc., 45 Halleck St., Newark 4, N. J. The bulletin tells how any gas that will ionize in water, with or without heat, can be determined and analyzed. It explains the operating principle of the unit and includes a toxicity table for 73 gases or vapors. The table specifies the maximum allowable concentration for each and gives the authority for the determinations.

Arc Welding

No. 6698—Arc welding is being attacked in a way which is handicapping its application and promises to interfere with its future uses. The attack consists of writing into specifications expensive and impractical tests which have little to do with the excellence of the weld. This opinion, together with specific examples, is stated by James F. Lincoln, president, Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, in an article, Arc Welding Is Being Handicapped, recently reprinted by the company.

Ball Bearings

No. 6699—Jack & Heintz Precision Industries, Inc., Cleveland 1, Ohio, has published a new ball bearing catalog (No. 2001) which includes a section devoted to the company's precision ball bearing production methods. Millimeter equivalents, bearing specifications, and bearing equivalents are also included, as well as a comprehensive chart explaining the standard AFBMA bearing numbering code.

Bending Machines

No. 6700—Specifications, capacities, available dies, and other data on the production bending machines offered by Pedrick Tool & Machine Co., Inc., 3638-42 N. Lawrence St., Philadelphia 40, Pa., are contained in a new 16 page bulletin. In addition to describing the various types of the company's benders, the booklet contains general discussions on economic factors in tube bending, selecting a machine, bending applications, properties of sections to be bent, standard radii, and section moduli for pipe and tubes.

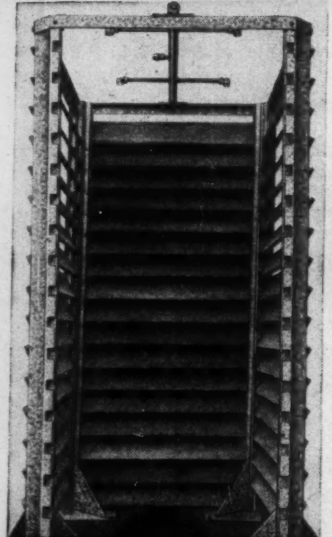
Built-In Motors

No. 6701—The Louis Allis Co., Milwaukee 7, Wis., has issued bulletin 516-D, describing its type CT rolled shell, shaftless squirrel cage induction motors for built-in drives. Details on electrical and mechanical features, mounting, ventilation, and application are included.

Computer for Corrosion Resistance

No. 6702—A new tool for judging corrosion resistance of nonferrous and stainless steel alloys in slide rule form has been announced by H. M. Harper Co., 2620 Fletcher St., Chicago 18, Ill. The instrument classifies the resistance of 13 nonferrous and stainless steel alloys in 142 corrosive applications with degrees of excellent, good, fair, and no good. Footnotes broaden its scope of application to include most of the common uses and many unusual ones. The company manufactures fastenings

BIG or small . . . there's a Binks atmospheric cooling tower to fit your particular needs



A Binks Type "S" Cooling Tower is ideal where there is natural air movement. This improved model is widely used for cooling condenser circulating water from refrigeration, and air conditioning compressors . . . for cooling all types of water-jacketed engines . . . for cooling water and other liquids from manufacturing processes.

Standard Binks Type "S" Atmospheric Spray Cooling Towers are built in 30 sizes with capacities from 10 to 1200 G.P.M. This wide range of sizes enables you to buy the best in cooling towers for any size installation without the added expense of a custom built tower.

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A data-packed booklet about Binks "S" Cooling towers, their specifications, capacities and much other helpful information.

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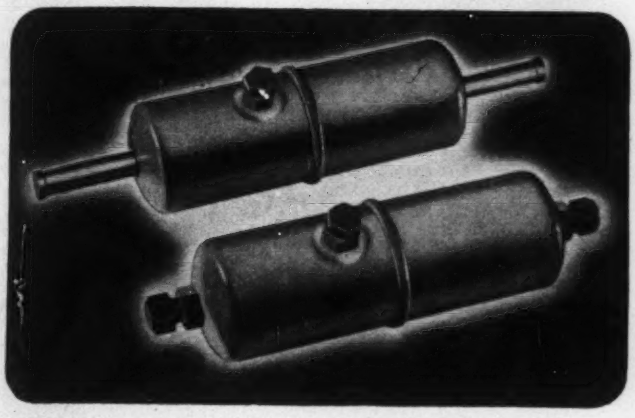
NOW... Keep Larger Systems Moisture-Free, Dirt-Free ...

Install New Large-Capacity, Rechargeable

TRAP-DRI **DRIER FILTER STRAINER**

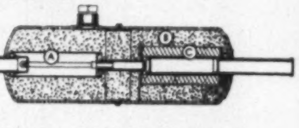


● **With a rating of up to 5 tons Freon these new larger A-P TRAP-DRI Drier-Filter-Strainers give you a welcome "break" on cleaning out larger systems, as well as providing for those small systems which need a larger capacity drier for preliminary cleanout. Now all your systems up to 5 tons Freon may be given the *extra protection* that means so much to improved system efficiency, avoidance of common troubles and service difficulties due to moisture, dirt, solder particles, scale, sludge and other impurities.**

The new larger A-P TRAP-DRI starts cleaning up your system immediately. Offering *minimum pressure drop,* it provides a filter unit as effective as a 900-mesh strainer (removing materials as small as 5 microns in size) . . . *plus* a highly-efficient and adequate charge of Silica Gel —53.7 cubic inches. This *drying agent may be removed and replaced, or dried out and re-used.*

Install the new A-P TRAP-DRI in your larger refrigeration systems — for improved operation, savings in service time, greater satisfaction and cost-savings for your customers. You'll find them at leading refrigeration wholesalers — or write for latest bulletins.

VERSATILITY IN INSTALLATION



The new TRAP-DRI is supplied in two types: Model DF-4, with ½'' male flare; or DS-5, with ⅝'' sweat connection. They may be easily connected to ⅜'', ½'', ⅝'', ¾'' or even ⅞'' tubing if desired. This ready versatility makes the new TRAP-DRI adaptable to a wide variety of systems.

Cross Section showing:
(A) Screen at inlet diffuses refrigerant into Silica Gel.
(B) Silica Gel drying agent (53.7 cu. in.)
(C) Honeycomb filter element traps impurities as small as 5 microns, by depth filtration principle.

AUTOMATIC PRODUCTS COMPANY
2460 North Thirty-Second Street
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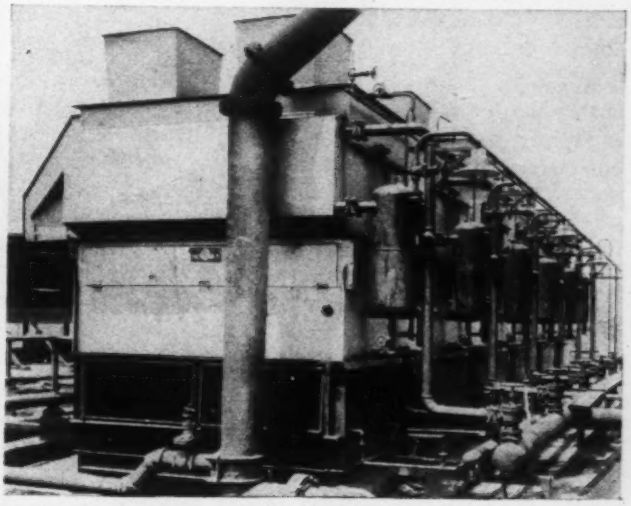
AP DEPENDABLE REFRIGERANT VALVES

STOCKED AND SOLD BY GOOD REFRIGERATION WHOLESALERS . . . RECOMMENDED AND INSTALLED BY LEADING REFRIGERATION SERVICE ENGINEERS

Sustained Performance
Increased Production
Lower-Cost Operation



● Refrigeration equipment, tending to decrease in effective capacity after a number of years in service, creates many production bottle-necks.

These can be opened up and production increased by installing a Niagara Aeropass Condenser (typical results: 10% capacity increase... plus 23% power saving ...95% of condenser water saved... with no addition to compressor equipment).

This performance is sustained for long life since the Niagara Aeropass Condenser lowers the condensing temperature to prevent any scale deposit on condenser tubes and effectively keeps oil from accumulating in the refrigerant lines.

In addition, with the patented Niagara "Balanced Wet Bulb Control", the Condenser will automatically, and for the year 'round, hold the head pressure to the minimum practical point for proper refrigerant distribution.

For complete description, write for Bulletin 103HP

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INDUSTRIAL COOLING • HEATING • DRYING
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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

and specializes in brass, bronze, monel, and stainless steels.

Control of Radiant Floor Panel Systems

No. 6703—"The building owners' primary concern is comfort, and comfort is what the average floor type panel heating system cannot and does not provide," according to a feature article in the October (Vol. 6, No. 11) issue of Weather Magic, house organ of The Trane Co., La Crosse, Wis. In this article, the first in a series on the control of panel heating systems, the discussion is confined to floor type panel systems in which copper or steel pipes are embedded in concrete slabs.

In support of this stand, which is certainly at variance with much of the currently published material, comfort is simply defined as an environment which is warm enough to allow the occupant to wear conventional indoor clothing without discomfort and cool enough so the occupant does not have to perspire or lose excess heat. Convector-radiator heating, in which comfort is attained by control of room air temperature, is briefly mentioned, and the author stresses that in floor panel heating systems, comfort can only be obtained when the room air temperature is reduced as the outside temperature decreases.

According to the discussion, this is both necessary and generally impossible because a decrease in outside air temperature necessitates a higher panel temperature to handle the increased load. This, in turn, reduces the heat loss of the body to surrounding wall, floor, and ceiling surfaces. To maintain a proper body heat balance the room air temperature will have to be decreased, but the room air absorbs heat by convection from the floor panel and by secondary convection from surfaces heated by radiation from the panel. Thus, there is no simple control of the room air temperature.

In regard to the problem of sluggishness or slow response to controls, it is pointed out that for a 20 x 20 ft radiant panel in a concrete slab such as is commonly used in the installation of floor panel systems, calculations show that a 10 percent reduction in heating load would require 2.7 hr in order to achieve equilibrium to the new load condition in the panel. Practically speaking, this is considered conservative because in most systems water circulation is continuous.

To overcome this problem the building must have a lag similar to that in the panel. This calls for the structure to be built of concrete, and it is stated that actually few buildings are so constructed. In fact, says the author, the usual installation is a concrete slab with a frame structure. A statement that "it is practically impossible to provide satisfactory control of a concrete panel in a frame building" is cited in further support of the article's conclusions. This statement appears in a control manufacturer's manual on radiant panel heating.

The problem of thermal lag caused by solar heat gain is stressed and a chart is used to show the influence of periodic sunshine on two unheated homes; one a solar type, the other of conventional design.

Mr. Heating Contractor:

McKEE AUTOMATIC Gas Fired "STEAMBOILERPLANTS"

Make More Money for YOU

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1. — McKee Eclipse Boilers are built "Better Than Code". They require little service, so you *keep* the profits you make!
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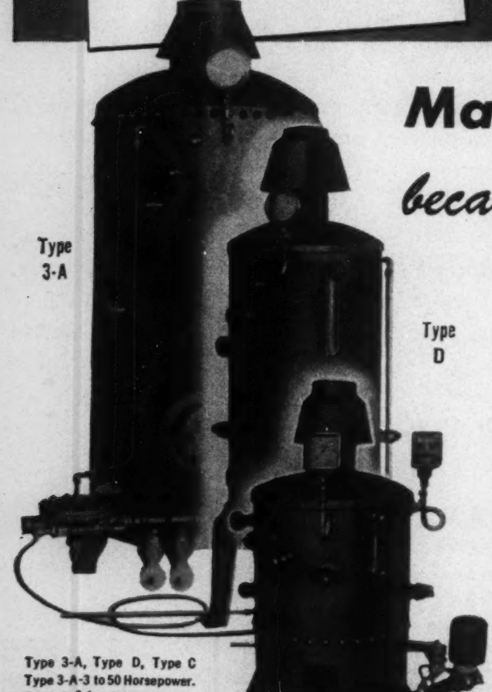
Write for complete details on STEAMBOILERPLANTS and our co-operation with Heating Engineers and Contractors.



Type 3-A, Type D, Type C
Type 3-A-3 to 50 Horsepower.
Type D-¾ to 7 Horsepower.
Type C-Same size as Type D, but faster for steam, ideal for gravity return.

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ECLIPSE FUEL ENGINEERING COMPANY
ROCKFORD, ILLINOIS
If it's for Gas—buy Eclipse

You Can Get It QUICKER

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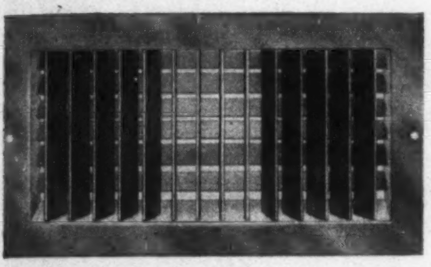
STEWART

NEW IMPROVEMENTS — NEW APPEAL IN HIGH VELOCITY OUTLETS

Improved throughout, the Stewart line of Outlets, Scoopaires, Wall and Baseboard Registers, will find a greater market than ever before in 1948. These redesigned units offer added beauty, more efficient diffusion control, easier adjustment. Yet, they are competitively priced, with shipments being made promptly. All popular types and sizes for air conditioning, heating and ventilating systems. Special sizes and shapes—including outlets curved to conform with contours—quickly produced to your specifications.



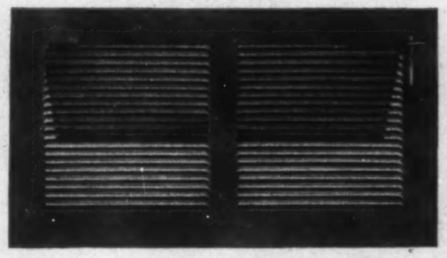
STYLE DDV

(2 Banks)
Individually
Adjustable
Face and
Rear Bars

• STYLE DDV is one of 8 variations of Stewart High Velocity Outlets. By means of a detachable key, all bars are adjustable for directing air straight and at various right-left or up-down angles. Style DDV has vertical face bars and horizontal rear bars. Style DDH (not shown) has horizontal face bars and vertical rear bars. This type of outlet is made in popular sizes with or without lever-operated, multiple volume valves. Matching intakes are available. OUTLETS CAN BE SUPPLIED TO FIT CONTOURS OF CABINETS FOR ROOM COOLERS

STYLE 91

Lever-operated
Single Damper
Wall Register



• STYLE 91 is from the series 70-90 of Wall and Baseboard Registers made with single dampers, or multiple-valve dampers, both lever operated. Face bars of the 90 series are horizontal and set down at a 22 degrees angle. Face bars of the 70 series are vertical, set straight. Setting keys are furnished for user to alter bar settings. Matching, fixed bar grilles are available.

Send for literature and prompt quotation on your requirements

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SMART ENOUGH NOT TO WORK ON THAT!

A squirrel has a hard time making a living. He can't afford to do useless and unprofitable work.

So, he inspects every nut he picks up. If he gets hold of a bad one, he throws it away.

The plumber or steamfitter doesn't have to inspect "K" fittings. Bad ones are thrown away at the factory. This saves the work and grief which would result from misalignment, leaks, call-backs.

Insist on "K" fittings.

- **Standard and Extra Heavy Cast-Iron Screwed Fittings**
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- **Standard and Extra Heavy Companion Fittings**
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Dayton 1, Ohio

K PRECISION FITTINGS

COMBINED MARKET FACILITIES at Malleable Iron Fittings Co., Branford, Conn., and at Kuhns Bros. Co., Dayton, Ohio.

Electric Control Motors and Motorized Valves

No. 6704—A six page article on electric control motors and motorized valves by S. D. Ross of Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia 44, Pa., is contained in the Vol. 3, No. 1 issue of Instrumentation, the company's house organ. The article provides basic information for the proper application of two common designs of electric power units offered by the company.

Electric Motor

No. 6705—Bulletin 2760, issued by Fairbanks, Morse & Co., Chicago 5, Ill., provides detailed information on the new "Axial Air-Gap" motor which ranges in size from 1/3 to 10 hp. Principles of the motor are said to be revolutionary in that the magnetic lines of force follow a path parallel to the shaft or axis of rotation. Outstanding features are said to include space and weight reduction, improved appearance, and the simplicity and speed with which it can be serviced.

Flow Meter

No. 6706—A new 12 page illustrated bulletin (No. 35-83A) on the "Adsco" flow meter of the orifice type for indicating, recording, and integrating the flow of steam, gas, and air has been released by American District Steam Co., North Tonawanda, N. Y. Details of construction, data on orifice plates, etc. are included.

Glass Fibers

No. 6707—"Vitron" glass fibers together with the plant and manufacturing facilities of the recently formed Glass Fibers, Inc., Waterville, Ohio, are described in a new bulletin. The fibers, which are said to have characteristics of benefit to weavers, braiders, and fabricators, are plied into continuous filament yarns of standard types and sizes to meet particular needs. While much of the production to date has gone into electrical insulation, the manufacturer states that glass fibers may be used to great advantage in a variety of applications which include electric motors, generators, transformers, and controls, many types of laminations, welding curtains, fire screens, filter cloth, underground pipe, and hose.

Hard Overlay Welding For Equipment Salvage

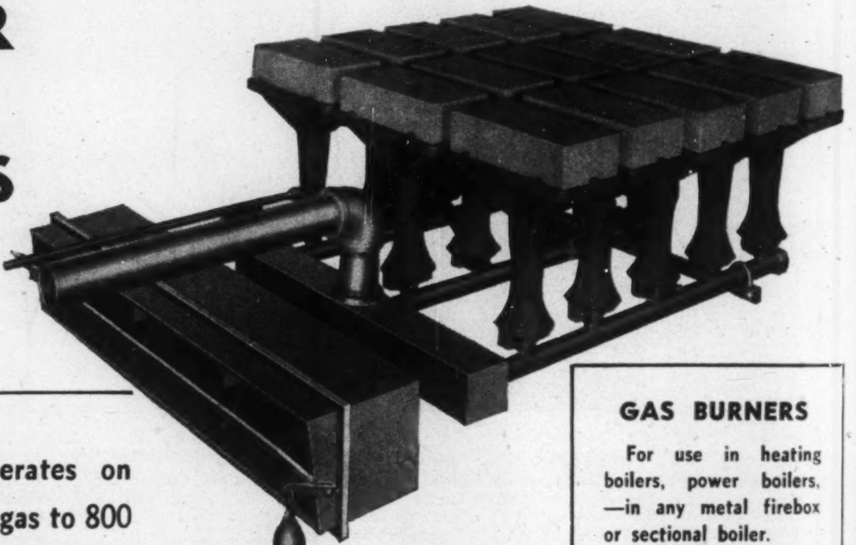
No. 6708—An eight page bulletin describing the specific procedures involved in industrial equipment salvage welding with various gas and arc rods for producing hard overlay at low temperature, has been released by Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y. Several new alloys for the hard overlay process are featured analytically by means of charts, data, and illustrations. The bulletin is included in the Vol. 4 No. 9 issue of the company's house organ.

Heating Equipment

No. 6709—Mechanically bonded heating coils, convector-radiators, and unit heaters, together with valves, traps, circulating pumps, and flow fittings are briefly described and illustrated in a new eight page booklet released by The Trane Co., La Crosse, Wis.

WEBSTER
Series F600
GAS BURNERS

50,000 to
10,000,000 Btu.



The Series F600 Burner operates on straight natural gas and mixed gas to 800 Btu. Gives perfect horizontal distribution. Fully automatic controls—that operate properly—can be easily applied.

Write for new illustrated Catalog of Webster Burners and Controls.

GAS BURNERS

For use in heating boilers, power boilers, —in any metal firebox or sectional boiler.

Adaptable to any firebox shape or size.

Handles various gas pressures and effects low draft loss.

THE WEBSTER ENGINEERING CO.
— DIVISION OF —
Surface Combustion Corporation . . . . Toledo, Ohio
TULSA OKLAHOMA

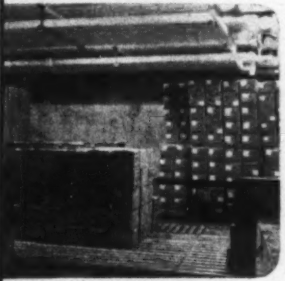
Pratt & Whitney Keep This Room at 68 deg. F, the Year 'Round.

Hold Any Temperature You Want with

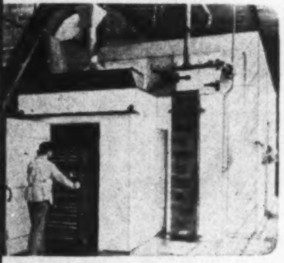
FRICK

Refrigeration

One-man One-shift Semi-Automatic Plant Makes 42 Tons of Ice Daily.

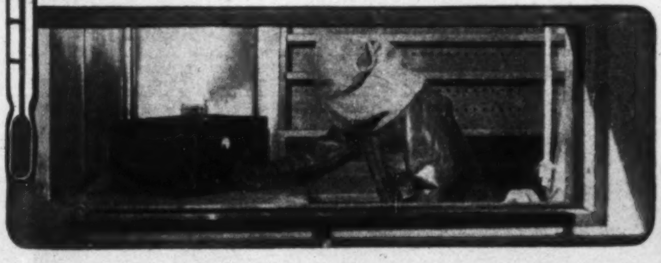


Frozen Foods Stored at –10° F. by Birds Eye-Snider.



Frick-Freezer Tunnel operated at –35° F. at Lancaster, Pennsylvania.

"Cold" down to 130 degrees below zero F. is now common in research and test work. Penicillin is dried at minus 75. Foods are quick-frozen at minus 30 to minus 60: are stored at zero to minus 20. Ice is frozen commercially in brine at 16. Fresh foods are held at 34 to 36. Drinking water is cooled to 45. Air conditioning, at 70 to 85, tops the scale of refrigerating loads. ● Whatever the temperature wanted, you can hold it most dependably with Frick Refrigeration. Sixty-five years' experience says so!



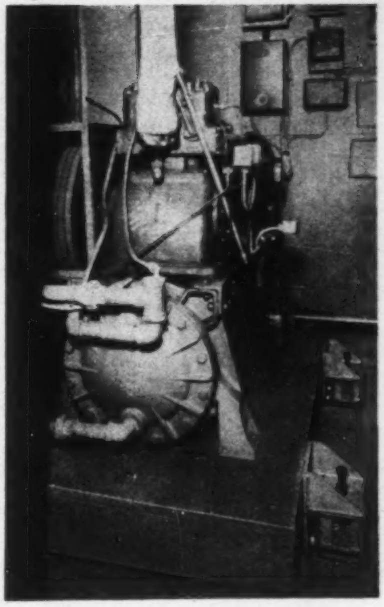
Test at –76° F. in a Refrigerated Laboratory of Bendix Radio.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK Co.

WAYNESBORO, PENNA. U.S.A.

AIR CONDITIONING *Silenced* by KORFUND



ADJACENT to a broadcasting studio on the eighth floor of a New York building, this 2-cylinder, 2,050 lb. compressor unit with speed of 650 RPM, 10 HP motor at 1,700 RPM, is installed on 1,800 lb. concrete slab, and side-mounted on four Korfund LK/D Vibro-Isolators with Elasto-Rib pads. These support the entire unit with no disturbing vibration or noise transmission.

EVERYONE knows that broadcasting studios have to be quiet. And since most broadcasting studios today are air conditioned, Korfund Vibration Control must keep air conditioning noises *off the air*. Korfund meets this test of vibration and sound control with especially designed Vibro-Isolator Units.

Whether *your* air conditioning is in a restaurant, department store, hospital or theater, one of its benefits is quiet operation. Korfund Vibration Control is the answer to air conditioning operating disturbance. Contact Korfund today for a discussion of your vibration and noise transmission problem. No obligation, of course.

KORFUND

VIBRATION CONTROL

THE KORFUND COMPANY, Inc., 48-36 32nd Pl., LONG ISLAND CITY 1, NEW YORK

Metal Tubing

No. 6710—A handbook on the selection, sizing, layout, and installation of metal tubing circuits has been published by Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio. The handbook is said to make available all basic data underlying the techniques required for the design and speedy installation of metal tubing. The 76 page manual covers system characteristics, choice of components, sizing, manipulation of flaring and bending tools, circuit measurements and layout, together with selection charts based on the flow required, pressures handled under varying services, and temperature conditions for meter and instrument systems.

Oil Burner Valves and Fittings

No. 6711—Double seat, double seal copper tube fittings and tank and control valves for city gases and petroleum products are described and illustrated in a 12 page folder (No. 102) issued by Hays Mfg. Co., 12th and Liberty Sts., Erie, Pa. Fittings described include adaptor couplings, elbows, tees, unions, and caps. Oil burner products include tank fittings, globe valves, tank valves, three-way stop cocks, and graduated dial stops.

Packaged Steam Generator

No. 6712—Packaged steam generators in 13 sizes up to 300 hp and for pressures from 15 to 200 psi are briefly described in a new bulletin (No. 28) released by Cyclotherm Corp., 90 Broad St., New York 4, N. Y. "Cyclonic Combustion," a patented method designed to provide complete diffusion combustion of gases and liquid fuels is explained at some length. The generators are designed to operate on any gaseous or liquid fuel.

Pipe and Flue Welders

No. 6713—The new F series pipe and flue welders manufactured by Thomson Electric Welder Co., Lynn, Mass., are briefly described and are illustrated in the Vol. 13, No. 10 issue of the company's house organ. Designed primarily for the salvaging and safe-ending of locomotive boiler tubes, these automatic machines are also used extensively for pipe welding.

Plastic Coated Pipe

No. 6714—The story of the development of plastic coated drill pipe for drilling oil wells in highly corrosive fields is told in a 22 page booklet recently issued by Spang-Chalfant Div., National Supply Co., Grant Bldg., Pittsburgh 30, Pa. The thermosetting plastic, which is applied to the inside of the pipe, resists the corrosive action of acids, alkalies, and salt. The bulletin also describes the problem of corrosion fatigue, its economic considerations, and the development of a similar coating for tubing used in producing wells.

Protective Coating

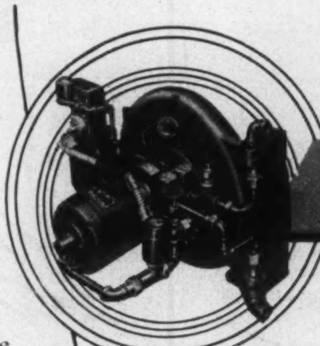
No. 6715—A 12 page catalog giving details on the chemical and physical properties, application instructions, and other pertinent data on protective coatings is now available from Amercoat Div., American Pipe and

Cordial Invitation

OUR increased production facilities and personnel enable us to satisfy the requirements of a few additional competent organizations capable of selling, engineering, installing, and servicing our complete line of industrial horizontal rotary oil burners.

You are invited to investigate the unusual sales and merchandising advantages of the Ace Uniflow Oil Burner.

A profitable opportunity awaits the right organizations.



Ace

UNIFLOW

HORIZONTAL ROTARY

HORIZONTAL ROTARY

OIL BURNERS

FOR PERFECT HEAVY OIL BURNING UNDER ALL OPERATING CONDITIONS

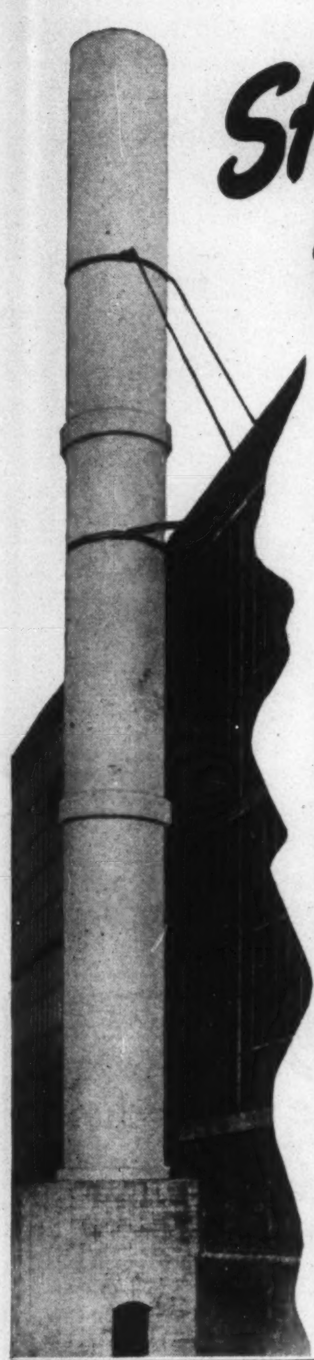
Models Available

	GALLONS PER HOUR	BOILER H. P.	SQUARE FEET STEAM RAD.
MINIMUM	2	6	800
MAXIMUM	165	500	64,000

ACE ENGINEERING CO.

1435 W. 15th Street • Chicago, Illinois

Custom Engineered Oil Burning Systems Since 1931



Still on the Job

AFTER MORE THAN 15 YEARS FIGHTING 2-WAY CORROSION

HERE IS ANOTHER EXAMPLE of the type of industrial venting service provided by Transite Industrial Vent Pipe.

For more than 15 years, this Transite stack at the Waterbury, Connecticut, plant of the Chase Brass and Copper Company has been exposed to conditions so severe, that the pipe previously used had to be replaced at frequent intervals. Its interior is constantly subjected to the destructive action of corrosive acid fumes . . . its exterior to the aggressive attacks of weather. Yet, despite this double-barreled attack from corrosion, it has required but very little maintenance *and is still on the job today.*

If you have a venting problem, this asbestos-cement pipe may prove a practical solution. Highly resistant to many of the corrosive gases, vapors and fumes met in industrial operations, it is providing long-term, low-cost performance in many industries. Rustproof and weather-resistant, Transite needs no painting. And it comes in sizes up to 36" in diameter, with a full line of Transite fittings to assure corrosion resistance throughout the system.

Data Sheet Series DS-336 gives you complete details and is free on request. Write Johns-Manville, Box 290, New York 16, N. Y. for your copy.

Typical Industries in which Transite Industrial Vent Pipe is used

- Aircraft
- Automobile
- Baking
- Bleaching
- Boiler Works
- Brewing
- Canning
- Ceramic
- Chemical
- Dairy
- Drug
- Electrical
- Explosive
- Farm Machinery
- Food
- Foundry
- Furnace
- Furniture
- Gas
- Glass
- Laboratory
- Laundry
- Leather
- Meat Packing
- Metal
- Mining
- Paint
- Petroleum
- Potash
- Pulp & Paper
- Quarrying
- Railroad
- Rayon
- Refrigeration
- Rubber
- Sewage Works
- Shipbuilding
- Shoe
- Smelting
- Soap
- Soft Drink
- Sugar Refining
- Textile
- Tool
- Water Works

Johns-Manville
TRANSITE Industrial Vent PIPE

BEND COLD PIPE QUICKLY, EASILY

● Speed piping installations this efficient, easy, economical way . . . make "on the job" bends in pipe up to 4½" with a GREENLEE Hydraulic Bender.

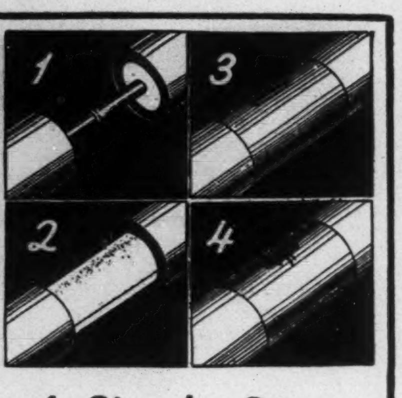
With a GREENLEE *one man* makes smooth, accurate, uniform bends in a few minutes. You save greatly through elimination of manufactured bends, many fittings, and the work of threading them. And, in timesavings alone, the GREENLEE pays for itself quickly.

Simple to operate, easy to carry, set up, and shift from job to job . . . lets you bend pipe exactly where and when you want it. Ideal for radiant heating jobs. For complete details write for free folder S-121. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2352 Twelfth Street, Rockford, Illinois.

SEE US AT THE EXPOSITION FEB. 2-6
BOOTHS 535 & 536 GRAND CENTRAL PALACE

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

Positive Protection



4 Simple Steps

1. Field joint ready for inspection. 2. Joint covered with standard pipe insulation. 3. Durant joint casing in place ready for asphalt. 4. Asphalt poured in slot making a perfect seal.

BUILT-IN at FACTORY

For all your underground and exposed piping jobs you'll like DURANT Pre-Sealed Insulated Pipe. It is waterproof . . . reduces installation costs to a minimum . . . eliminates electrolysis and corrosion . . . requires very little trenching and field work . . . avoids extra cost of waste and breakage . . . comes to you ready to install. In short, D.I.P. is the *perfect pipe* for this type of job. Investgate D.I.P.! Write for details today.

Ready to Install

PRE SEALED

D.I.P.

FOR STEAM
HOT WATER
REFRIGERATION
Trade Mark

Reg. U.S Pat. Off.

Durant
INSULATED PIPE CO.
1015 Runnymede St.
Palo Alto, Calif.

The ORIGINAL Pre-sealed Insulated Pipe

RADIANT HEAT PIPE BENDING IS EASY, FAST with "American" MACHINES

Hand powered, the A-30 bends ½ to 2" standard pipe sizes at a radius of 5 to 1, up to 180°. Special radii can be supplied within these sizes.

Extra fast! — average bend made in 60 seconds! Versatile! — bends cold pipe, conduit and tube, copper and brass I.P.S. without crimping. Our world-wide customers include the United States Government, 9 foreign governments, and over 12,000 of the world's largest industrial plants.

Among these are:

CRANE CO.
STATE OF VIRGINIA
E. I. DU PONT
AMERICAN VISCOSE COMPANY
MONSANTO CHEMICAL COMPANY
MIDWEST PIPING & SUPPLY COMPANY
AUSTIN SUPPLY COMPANY
PITTSBURGH PIPE & EQUIPMENT COMPANY
NEW ENGLAND RADIANT HEATING COMPANY
RIGGS DISTLER COMPANY
ILLINOIS CENTRAL RAILROAD
FREDERIC B. STEVENS, INC.
STONE & WEBSTER

"American" PIPE BENDING MACHINE Company INC.

FACTORY AND MAIN OFFICE:
17 Furnace Street, Poultney, Vermont
Export Dept.: 21 State Street, New York 4, N. Y.

Construction Co., P. O. Box 3428, Terminal Annex, Los Angeles 54, Calif. Catalogs are available for 10 major industries, giving technical information pertaining to each industry.

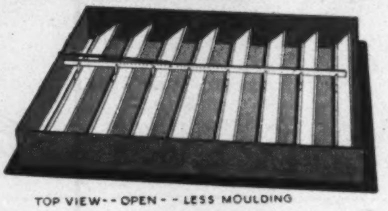
Radiant Heating Installations

No. 6716—What We Learned from 1000 Radiant Heating Installations is the title of a 12 page booklet published by A. M. Byers Co., Clark Bldg., Pittsburgh 22, Pa. General data from the company's files on 1000 installations are presented in this folder, and advantages such as uniform heat distribution and fuel savings are cited. Of the installations analyzed 28 percent were in commercial buildings, 16 percent were in industrial structures, and 8 percent were in institutional buildings such as schools, hospitals, churches, and libraries. In these particular installations 93 percent used floor type coils exclusively. There were no projects where wall coils carried the load alone. In a number of installations both floor and ceiling coils were used, and 95 percent of all coils were welded. Sinuous coils were used in 55 percent of the structures and grid coils were used in the remaining 45 percent.

Refractory Backing For Water Walls

No. 6717—Geo. P. Reintjes Co., 2517-19 Jefferson St., Kansas City, Mo., has issued bulletin No. 947 on its flexible, unit supported, insulated refractory backing for close spaced water walls. Features are said to include:

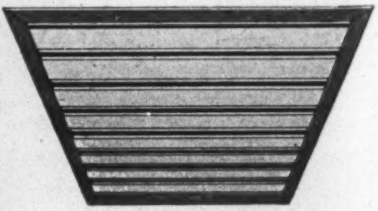
AIR-FLO AUTOMATIC CEILING SHUTTER



TOP VIEW - - OPEN - - LESS MOULDING

FOR ATTIC FANS

Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 5 different widths, single panel up to 73" long. No operating mechanism shows. Built-in fusible link. Meets fire underwriters requirements. Write for illustrated catalog 42-D of the complete AIR-FLO line.



VIEW FROM BELOW - - CLOSED (with moulding)

AIR CONDITIONING PRODUCTS CO.
2340 W. Lafayette Blvd., Detroit 16, Mich.

Every

PHOENIX FLANGE

is precision drop-forged

From raw billet to finished product, Phoenix Flanges are forged by men who know precision work. That's why Phoenix Flanges always fill your needs exactly. That's why they always meet ASA requirements and ASME and ASTM specifications.

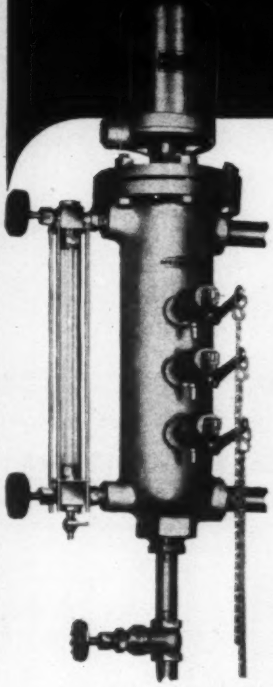
The mild steel in these flanges is readily machined and welded . . . yet drop-forging imparts a toughness that means long service under any conditions.

Get your copy of the Phoenix Flange Catalog today. It shows the complete line.

PHOENIX
Drop △ *Forged*
FLANGES

PHOENIX MANUFACTURING COMPANY
Joliet, Illinois △ Catasauqua, Pa.

NOW— Water Column and Positive Automatic Level Control in a SINGLE UNIT with MAGNETROL



• Here's the answer to a long-felt need — a new Magnetrol all-in-one-unit water column and boiler water level controller. Just check its advantages: It costs less, installed, than a separate water column and cross-connected controller. It's more reliable — no cross-connection piping to become clogged; also allows closer "following" of boiler water level changes. It reduces boiler maintenance — only one blow-down instead of two. It's easier to install. It saves space.

The float chamber in this all-in-one Magnetrol has been made longer, and has tapped outlets for gauge glass and three try-cocks — conforming fully to A.S.M.E. Code Water Column Requirements. Model W-251, illustrated, for pressures up to 250 lbs. Model W-126, pressures up to 125 lbs.

MAGNETROL MEANS GREATER SAFETY

Provides a truly fool-proof method of pump control, low water fuel cut-off and low water alarm. (High water alarm ana cut-off function also available). Level changes are transmitted to the switching mechanism by magnetic action . . . *no bellows* . . . *no stuffing box* . . . *no diaphragms* . . . *no electrodes*. New "Unitary" Switching Mechanism is completely self-contained — installed or replaced as simply as changing cells in a flashlight. Switch spacing and level differential easily adjusted.

MAGNETROL STANDARD MULTI-STAGE CONTROLS

Incorporate all the notable Magnetrol features. Normally provides 2-stage control — upper stage starts and stops boiler feed pump, lower level controls low water fuel cut-off or alarm, or both. A third level stage can be added, for two-stage pump control. Model 251, pressures up to 250 lbs. Model 126, pressures up to 125 lbs.

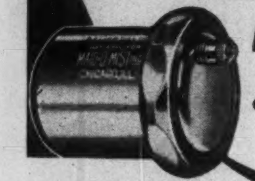
MAGNETROL SINGLE-STAGE CONTROL

Model 249 (Pressures up to 250 lbs.) Ideal for low water cut-off and/or alarm function only, at low cost.

Write for Bulletin 147 and full information on Magnetrol Boiler Water Level Controls.

MAGNETROL, Inc.
A Division of Fred H. Schaub Engineering Co., Inc.
2116 S. Marshall Blvd. Chicago 23, Illinois

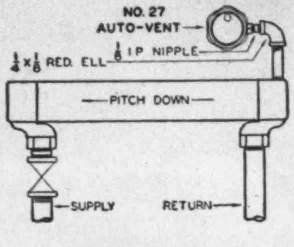
HOW TO GET **PERFECT CIRCULATION** in Hot Water Radiators and Convectors



AUTO-VENT AIR ELIMINATORS REALLY DO A JOB!

As air accumulates in radiators or pipes, it is AUTOMATICALLY VENTED when you use these inexpensive No. 27s. Your customer gets better heating and saves fuel.

AUTO-VENTS work equally well on convectors, baseboard radiation, panels, radiant heating coils, etc. — NO AIR CHAMBER REQUIRED. Good for pressures to 50 lbs. *See your jobber, or write us direct.*



SIMPLE AS A-B-C

Detailed drawing of No. 27 Auto-Vent Air Eliminator operating on convector radiator. Auto-Vents used on other types of jobs are just as easily installed — and no attention required.

MAID-O-MIST INC.
3215 N. PULASKI RD.
CHICAGO 41, ILLINOIS

AUTOMATIC HUMIDIFIERS FOR ALL TYPES OF HEATING SYSTEMS

(1) the entire boiler can be enclosed with refractories before any insulation is applied, (2) the insulation can be applied in its entirety before a steel casing is installed, in fact, no steel casing is required, and (3) the tiles, attached to the tubes, can move with them.

Registers and Return Air Grilles

No. 6718—Publication of a new catalog (No. 48) has been announced by Auer Register Co., 3608 Payne Ave., Cleveland 14, Ohio. The catalog lists and illustrates all items in the company's line of registers and return faces for gravity and air conditioning systems, including the latest adjustable and air directional types.

Selecting Steel Valves On the Basis of Superheat

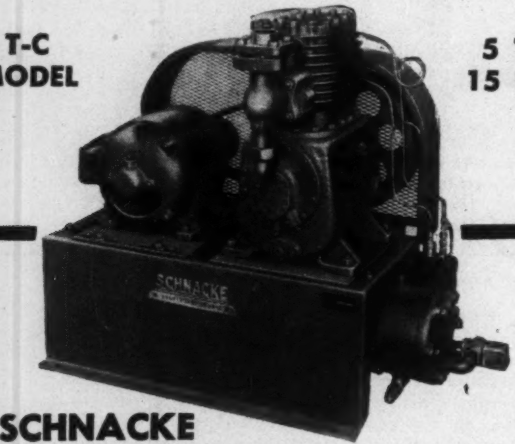
No. 6719—Standard B16e-1943 of the American Standards Association provides temperature-pressure ratings for various steel valves. For occasions where it is more convenient to use degrees superheat, Newton Ewalt of Walworth Co., 60 E. 42nd St., New York 17, N. Y., has prepared a selection chart ranging from 100 to 2200 psig and from 0 to 500 deg superheat. The chart is reproduced in the Vol. 7, No. 3 issue of the company's house organ. Also included in this issue is a brief discussion of the development and growth of the liquefied petroleum industry. Applications of the company's globe and angle bronze valves in this field are cited.

Self Priming Pump

No. 6720—The automatic, self priming pump offered by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., is

T-C MODEL

5 TO 15 H.P.



SCHNACKE COMPLETE CONDENSING UNITS
For Air Conditioning and Refrigeration

SCHNACKE Compressor has replaceable, refrigerant-cooled steel cylinder sleeves, balanced forged crankshaft, sealed crankcase, complete pressure lubrication, and many other advanced features.

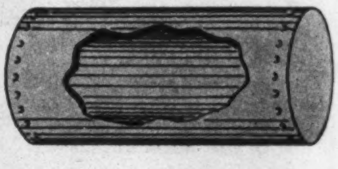
Condenser is ASME approved, fin tube, cleanable type, mounted in sturdy base. Water control valve and pressure control installed. F-C Models 10 to 25 H. P. available. Models less condenser, from 5 to 50 H.P.

Our new foundry now makes deliveries on most models possible in one to two weeks.

Write SCHNACKE, INC., 1020 E. Columbia St., Evansville, Ind., for complete details.

SCHNACKE, INC.

NEW LIFE! to Old Water Tanks



WITH APEX PERMANENT PORCELAIN LINING. Pitted or leaky water tanks can be restored to original usefulness by relining, applied in two coats approximately ¼″ thick—cures under water—has an affinity for lime—prevents corrosive and pitting action on metal—withstands temperatures up to 250° without cracking—adds years to life of tank.

RIDAL SERVICE CLEANS CHEMICALLY STEAM & WATER SYSTEMS. Eliminate sludge and foreign matter from your entire plant safely and economically. We clean and restore to original operating efficiency CHEMICALLY such equipment as: TURBINES — CONDENSERS — STEAM FEED LINES — CONDENSATE RETURNS —WATER HEATERS—STEAM KETTLES—COOLING AND HEATING COILS — PREHEATERS — HEAT EXCHANGERS — EVAPORATORS — TRAPS OF ALL KINDS — ETC.

Consultation Service—Without Obligation

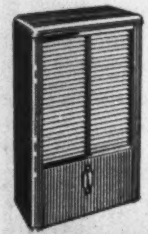
APEX Engineering Company
75 E. WACKER DRIVE CHICAGO, ILL.

REZNOR
the Automatic
GAS FIRED HEATER

WITH THE
BIG,
QUIET
FAN

Maximum heat transmission is made possible by the flat, oval Reznor designed heat exchanger tubes that yield more heat to the soft rush of air from the fan. The heaters are efficient, economical and AUTOMATIC.

Floor or suspended type, automatic, gas fired Reznor heaters provide abundant, automatically controlled heat to homes, apartments, offices, factories, warehouses, garages, stores, restaurants and auditoriums. To end heating problems for any size area, write today.



REZNOR
Gas fired unit heaters

SUSPENDED OR FLOOR MODEL

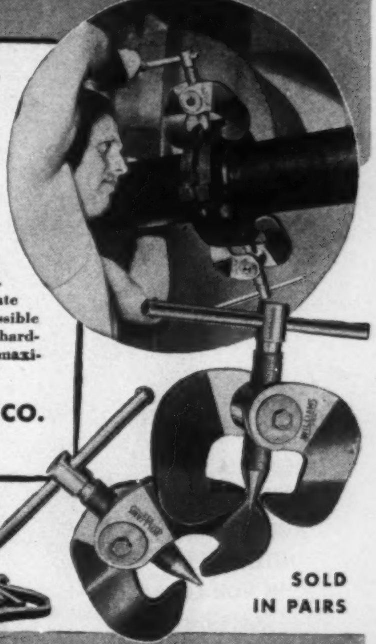
A SIZE FOR EVERY NEED

REZNOR CO. MERCER, PENNA.

GAS FIRED HEATERS SINCE 1888

NO BOILERS • NO STEAM LINES
NO FUEL STORAGE • NO FIRE TENDING

FOR
FAST • SAFE • EASY
GASKET REPLACEMENT



The only tool that takes the guesswork out of replacing gaskets, regardless of location. Flanges are parted quickly and held in perfect alignment without damage to faces . . . shock and jarring of pipe lines are eliminated . . . there is no danger from flying wedges . . . no sparks caused by hammer blows. FLANGE-JACKS eliminate costly shutdowns, make possible fast, economical repairs in hard-to-get-at locations, offer maximum safety.

J. H. WILLIAMS & CO.
Buffalo 7, N. Y.

Standard No. 20	**$24.00 a pair**
Giant No. 30	**$48.00 a pair**

See your distributor for trade discounts

SOLD IN PAIRS

WILLIAMS
Flange-Jacks

QUALITY always wins!

MARTOCELLO
Products are fully
DEPENDABLE

ATOMIZING SPRAY NOZZLES
(1930) ⅜" P.S. MALE
(1910) ¼" P.S. MALE
⅜" P.S. FEMALE
(1920)
(2300) ½" P.S.
(2304) ½" P.S.
(2308) ¾" P.S.
SPRAY POND NOZZLES
CONDENSER WATER DISTRIBUTOR

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost.

It will pay you to consult us. WRITE or WIRE for further information.

Jos. A. Martocello & Co.
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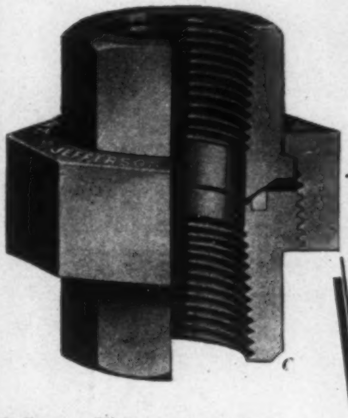

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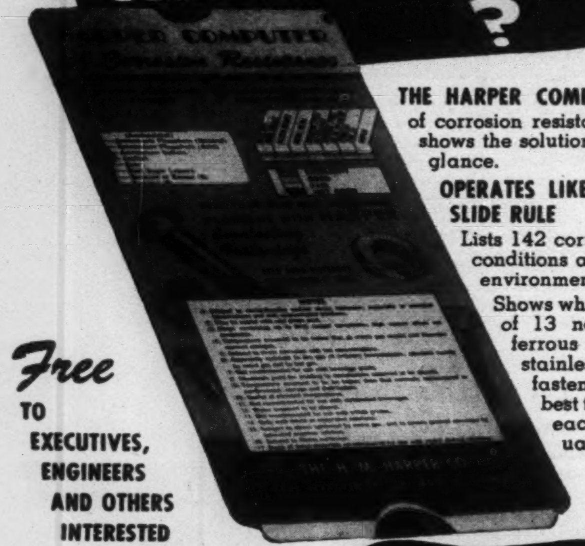

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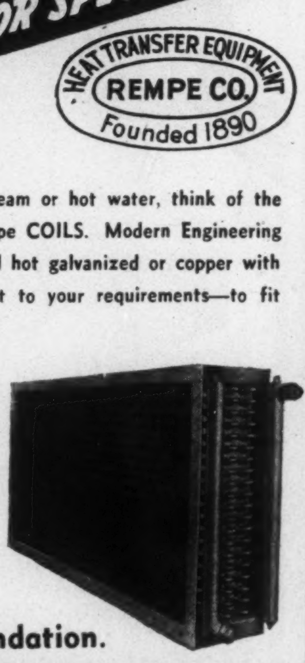

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equipped with a new type automatic spring valve said to give faster, smoother transition from priming or vacuum pumping to straight centrifugal action. It is described in a new eight page bulletin (08B6319B), is said to be adaptable to any drive, and is available in five sizes.

Solenoid Contactor

No. 6721—The new size 1, a-c solenoid contactor is the first of a new line of a-c control equipment offered by Ward Leonard Electric Co., 31 South St., Mount Vernon, N. Y. It is said to be especially applicable for use as main line, reversing and accelerating contactors on a-c motor controllers operating single or multi-speed polyphase induction motors, single phase motors, or slip ring motors. Pertinent data are provided in bulletin No. 4451.

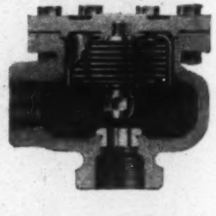
Steam Boilers

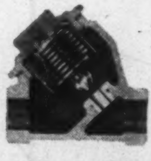
No. 6722—A new 12 page bulletin published by Springfield Boiler Co., 1939 E. Capitol Ave., Springfield, Ill., covers the company's line of two drum, bent tube and sectional header cross drum boilers. Also included is the type M standardized boiler for small and medium size plants. Performance data, dimensions, etc. are given.

Steam Hose

No. 6723—"Ajax" and "Conservo" brands of steam hose are described in a new folder issued by Hewitt Rubber Div., Hewitt-Robins Inc., 240 Kensington Ave., Buffalo 5, N. Y. Designed for general steam hose service, they

Are Steam Traps Your NO. 1 FUEL WASTERS?





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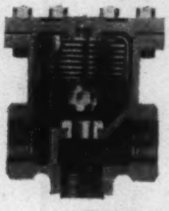

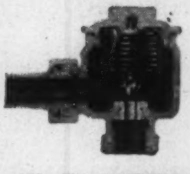

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See other Advertisement on Page 4
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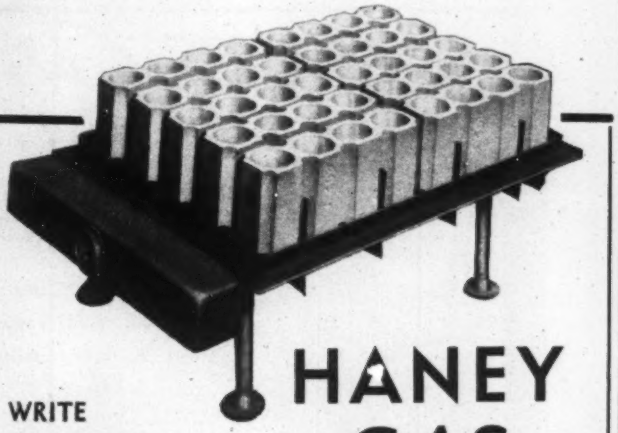

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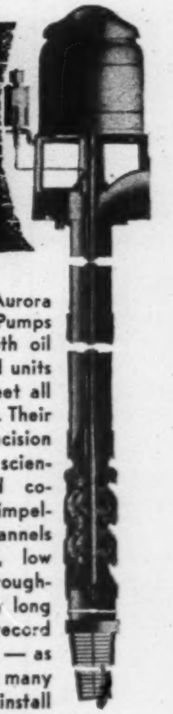

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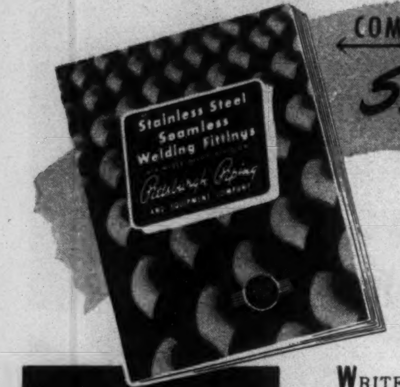

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Synthetic Coating

No. 6724—An elastic, baking synthetic, the thickness of which can be varied by application method, is described by United Chromium, Inc., 51 E. 42nd St., New York 17, N. Y. in a new four page bulletin on "Unichrome" coating 218. Though dealing mostly with the application of the coating on electroplating racks, advantages for the use of any parts or equipment which need extra tough coatings are indicated.

Temperature and Humidity Indicator

No. 6725—The "Airgraph," an instrument for registering temperature and humidity on drum scales, is also designed to indicate healthful balances between the two by means of comfort zones imprinted as black areas on the dials. These zones are said to coincide with those on the ASHVE comfort chart. The unit is described in a leaflet issued by Middleburg-Carson Mfg. Co., 549 W. Randolph St., Chicago 6, Ill.

Testing and Measuring Equipment

No. 6726—Detailed information on more than 90 products for specialized testing and measuring is contained in a new 43 page catalog (No. GEA-639) published by General Electric Co., Schenectady, N. Y. The many instruments described include magnetic equipment; time, speed, and torque measuring equipment; force, strain,

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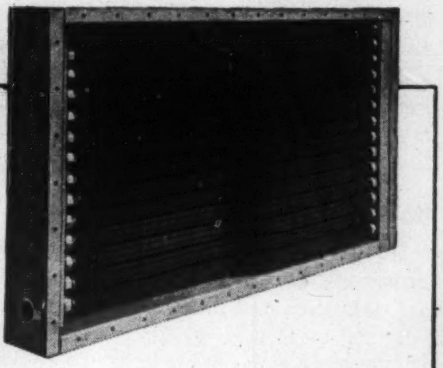

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No. 6727—Horizontal unit heaters for commercial and industrial use and for steam or hot water applications are described and illustrated in a new bulletin (No. 4710) released by Kennard Corp., 1819 S. Hanley Rd., St. Louis 17, Mo. The units incorporate plate type aluminum fins, continuous in width and depth, bonded to tubes of seamless copper. Steam capacities range from 26,500 to 268,300 Btu per hr.

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No. 6728—Pre-engineered "Texrope" drives is the subject of a new 144 page catalog released by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. Nearly two-thirds of the booklet is devoted exclusively to pre-engineered stock drives for all applications from 1 to 150 hp. More than 22,000 stock drives are listed in this section. Drives for all horsepowers, motor speeds, ratios, and driven speeds are listed according to horsepowers. New pitch diameter sizes of B and C "Magic-Grip" sheaves are used in many of these drives. According to the manufacturer this method of pre-engineering insures the selection of the most economical and best drive from an engineering standpoint.

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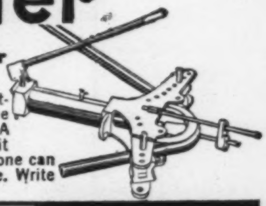

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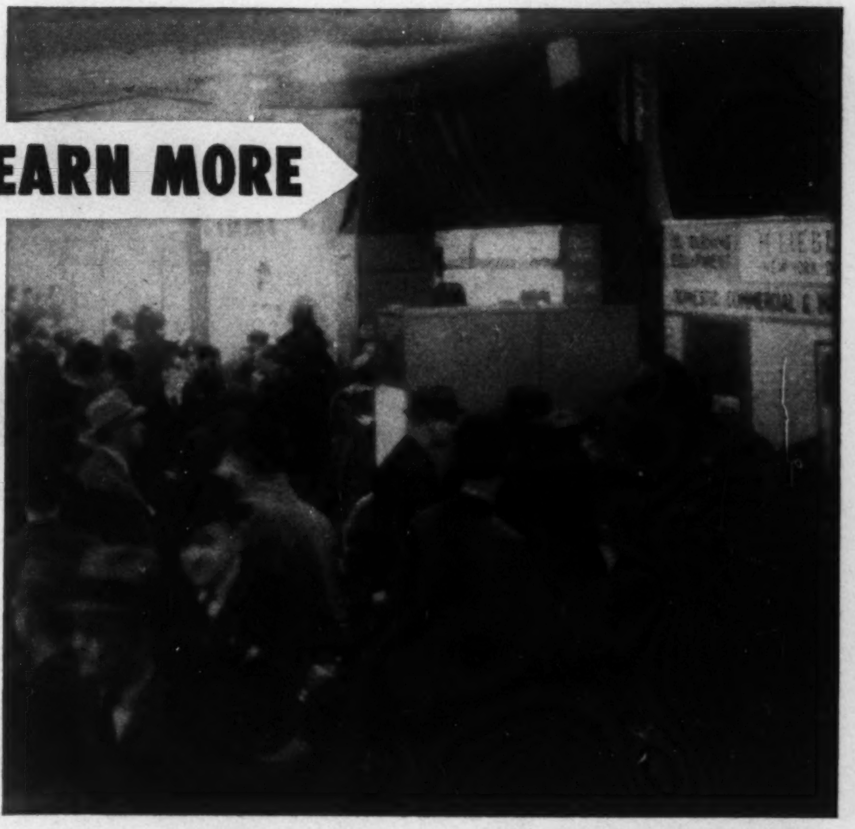

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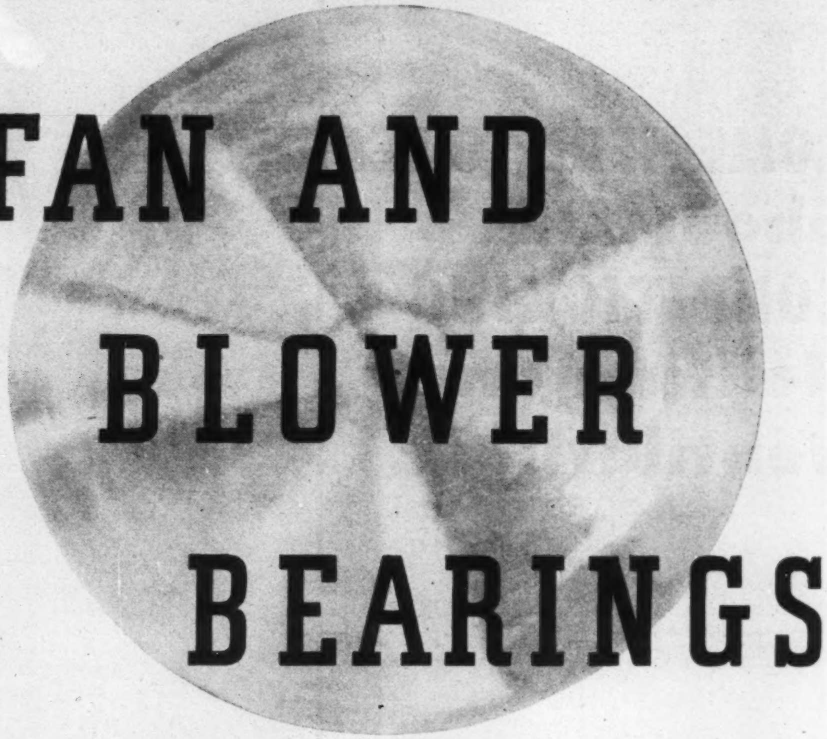

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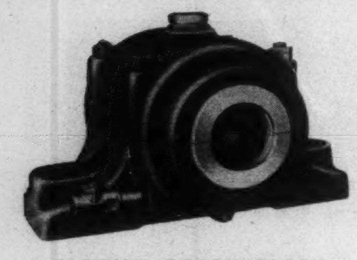

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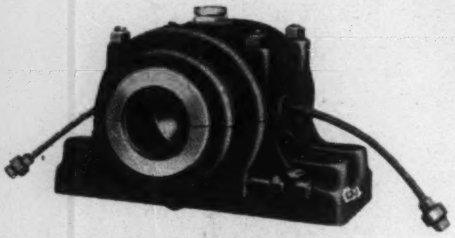

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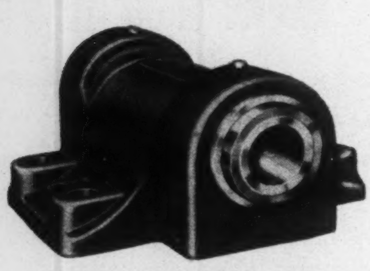

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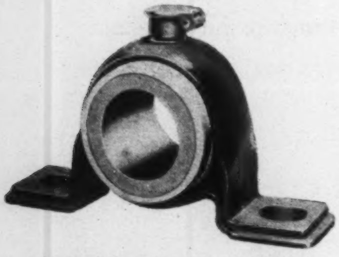

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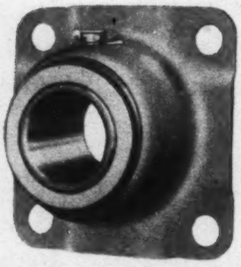

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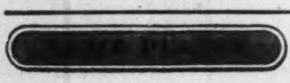

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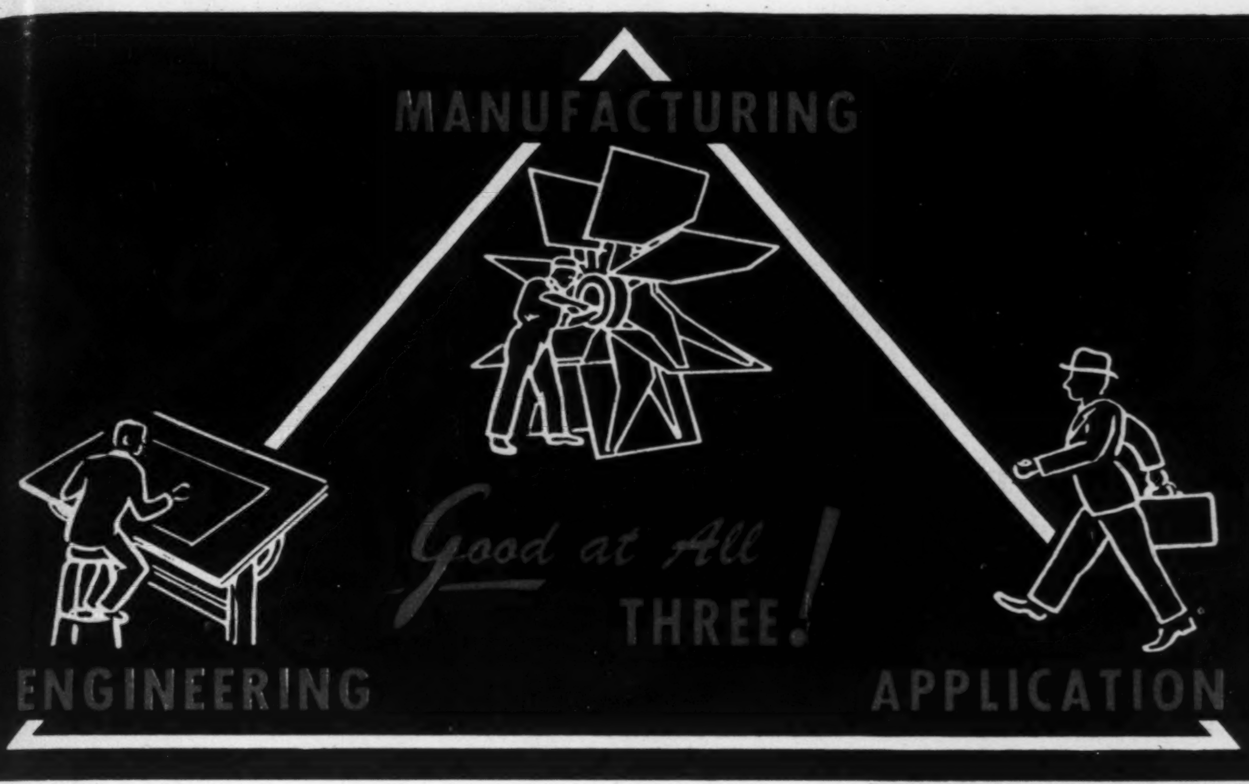
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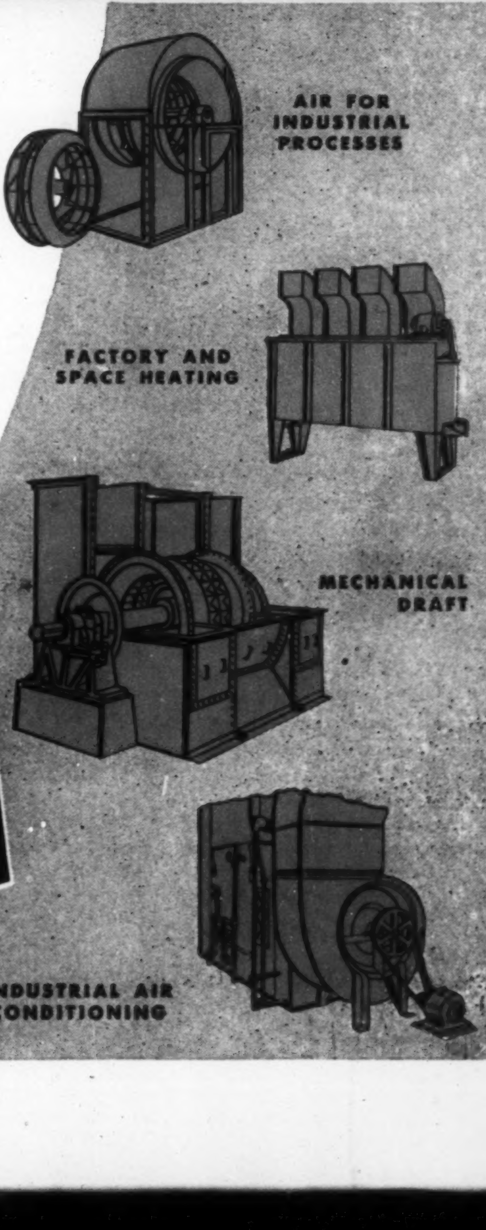
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